

3D-AQS: A Three Dimensional Air Quality System

Applications of Environmental Remote Sensing
into Air Quality and Public Health
Potomac, MD May 8-9, 2007

smoke

sun glint

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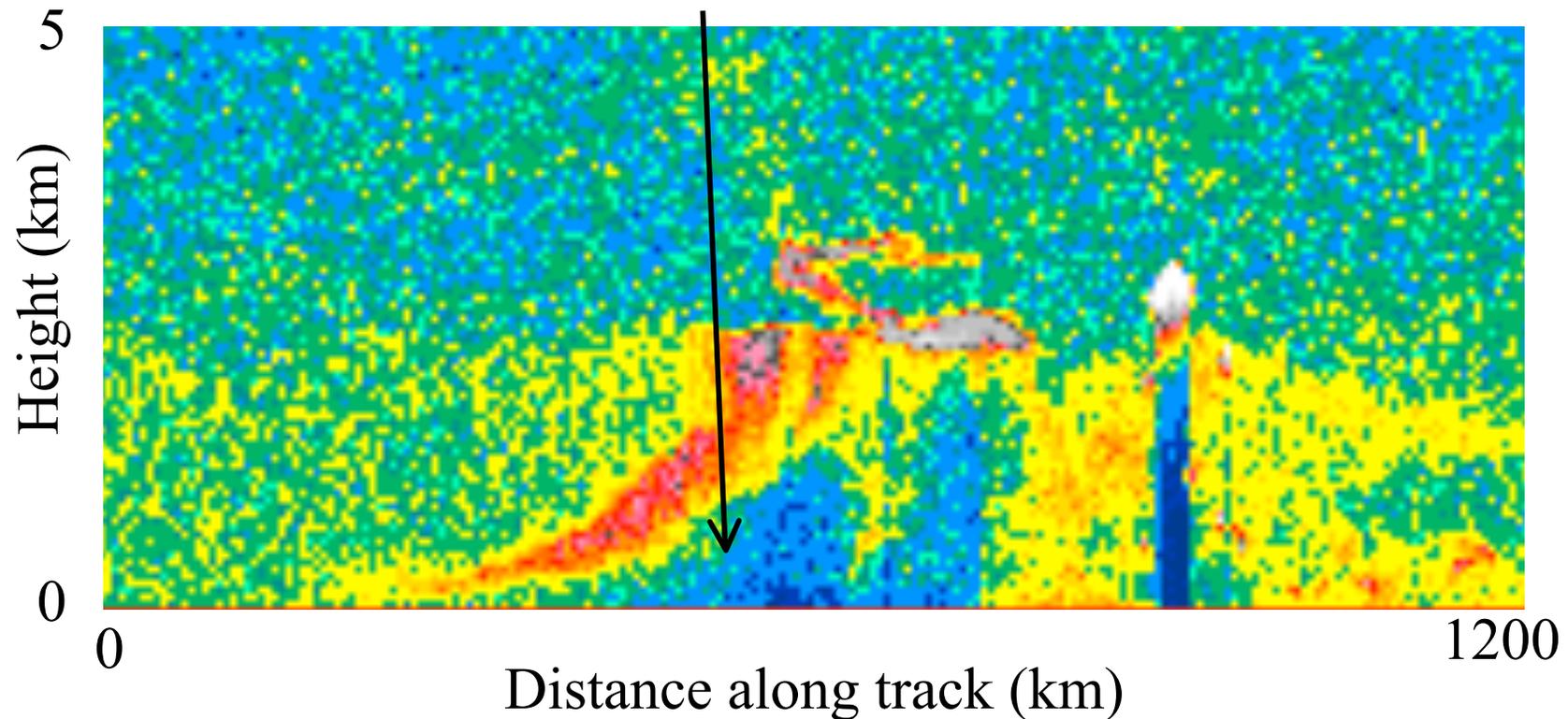
Fred Dimmichele, Szykman, Brad Johns, U.S. EPA
Anthony Wimmers, Steve Ackerman University of Wisconsin
Shobha Kondragunta, NOAA
Jassim Al-Saadi, NASA
Chieko Kittaka, SAIC
Erica Zell, Battelle
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MODIS 29 April 2007

Data from NASA GSFC and University of Wisconsin

The same plume in the vertical

This is why ground monitors in GA are not ringing bells



(more on this later.....)

Overview

- Overview of 3D-AQS project
- Current data and why EPA is interested in satellite and lidar data for aerosols
- Quick overview of existing satellite data
- Quick overview of lidar
- Status of 3D-AQS project
- How you can access these data and provide input to 3D-AQS

Why are we interested in measuring air quality data in 3D?

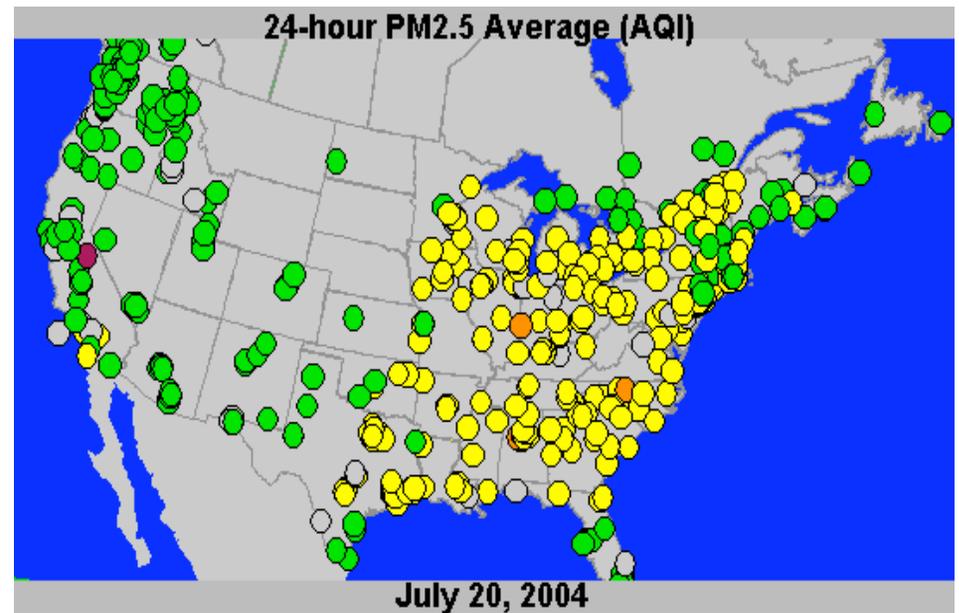
- Regional haze and regional scale events
- Long and medium range transport
- Clean Air Interstate Rule
- Improved modeling and validation of models
- Regulatory accountability
- Health endpoints?

Satellite sensors can provide horizontal data coverage, ground and space-based lidar can measure aerosols in the vertical dimension.

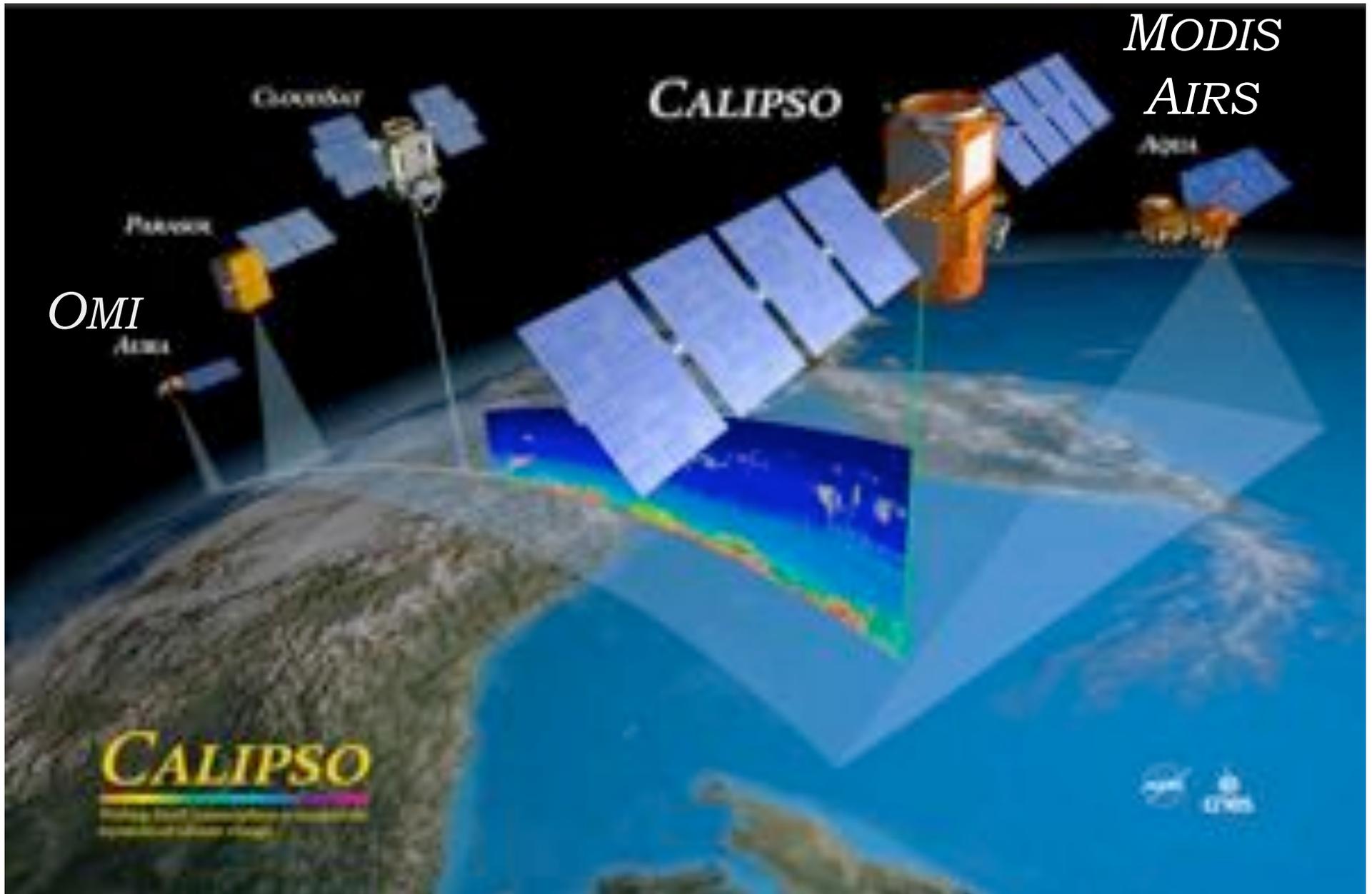
"At this point, we are ants on a two dimensional world...."

Current Datasets: Ambient Air Monitoring for Aerosols

- “True” measure of air quality
 - Varying temporal scales (hourly, daily, 1 in 3 days)
 - Sparse networks spatially
- Ground-based concentration in mass units ($\mu\text{g} / \text{m}^3$)
- Monitors usually sited in urban or rural areas only, e.g.,
 - Urban FRM network
 - IMPROVE in Class I areas
- Used for forecasting and historical analysis (including compliance)
- Decision support systems include:
 - AQS / AirQuest (<http://www.epa.gov/ttn/airs/airsaqs/>)
 - AIRNow (<http://www.airnow.gov>)



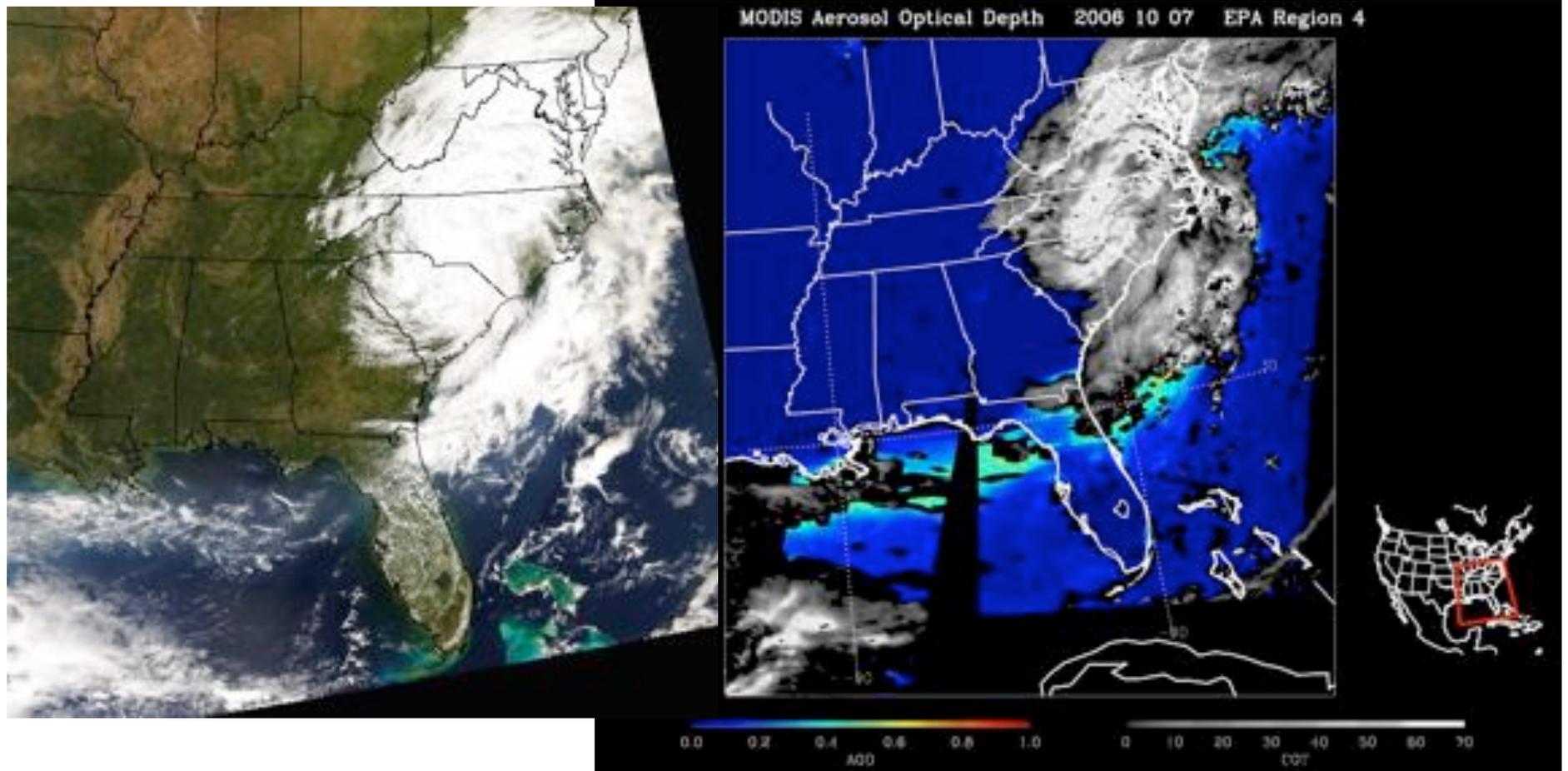
Some key air quality satellite sensors



MODIS Direct:

<http://eosdb.ssec.wisc.edu/modisdirect/>

IDEA: <http://idea.ssec.wisc.edu/>



MODIS Terra, October 10, 2006
MODIS Direct and IDEA run by UW-SSEC

UMBC data
can all be
found at
<http://alg.umbc.edu>



The image shows a screenshot of a web browser displaying the homepage of the UMBC Atmospheric Lidar Group. The browser's address bar shows the URL <http://alg.umbc.edu/>. The page features a header with the group's name, "UMBC Atmospheric Lidar Group", and logos for the University of Maryland System (UMBC) and the Joint Center for Earth Systems Technology (JCEST). Below the header, there is a section titled "Atmospheric Lidar Group Description:" which provides an overview of the group's research interests in aerosol and aerosol properties. A link for "Current UMBC-ALG Webcam Image" is also visible. The "Projects:" section lists several key initiatives: US Air Quality, REALM (Regional East Atmospheric Lidar Mesonet), ELF (Elastic Lidar Facility), UMBC Nephelometer, and ALEX (Atmospheric Lidar Experiment).

UMBC Atmospheric Lidar Group Homepage

http://alg.umbc.edu/

UMBC Atmospheric Lidar Group

UMBC
UNIVERSITY OF MARYLAND SYSTEM

JCEST

Atmospheric Lidar Group Description:

We are interested in remote sensing of the atmosphere with a focus on aerosols and aerosol properties. We have two Light Detection And Ranging (LIDAR) Facilities that allow us to make active measurements of the aerosols in the atmosphere. We also have a nephelometer to make ground measurements of aerosols. We also utilize passive instruments such as satellites to look at the regional variability and development of aerosols.

[Current UMBC-ALG Webcam Image](#)

Projects:

- US Air Quality**
 - The USAQ smog blog is a daily diary of the U.S. air quality. We use information from NASA satellites, ground-based lidar, EPA monitoring networks, and other monitors to reinforce our posts.
- REALM**
 - Regional East Atmospheric Lidar Mesonet (REALM) is designed to monitor air quality in the vertical from multiple locations on the east coast.
- ELF**
 - Elastic Lidar Facility (ELF) that operates at 532nm. It measures aerosol profiles of the atmosphere.
- UMBC Nephelometer**
 - The UMBC Nephelometer makes a ground measurement of the backscatter coefficient.
- ALEX**
 - Atmospheric Lidar Experiment (ALEX) is a Raman lidar that operates at



U.S. Air Quality (The Smog Blog), <http://alg.umbc.edu/usaq>

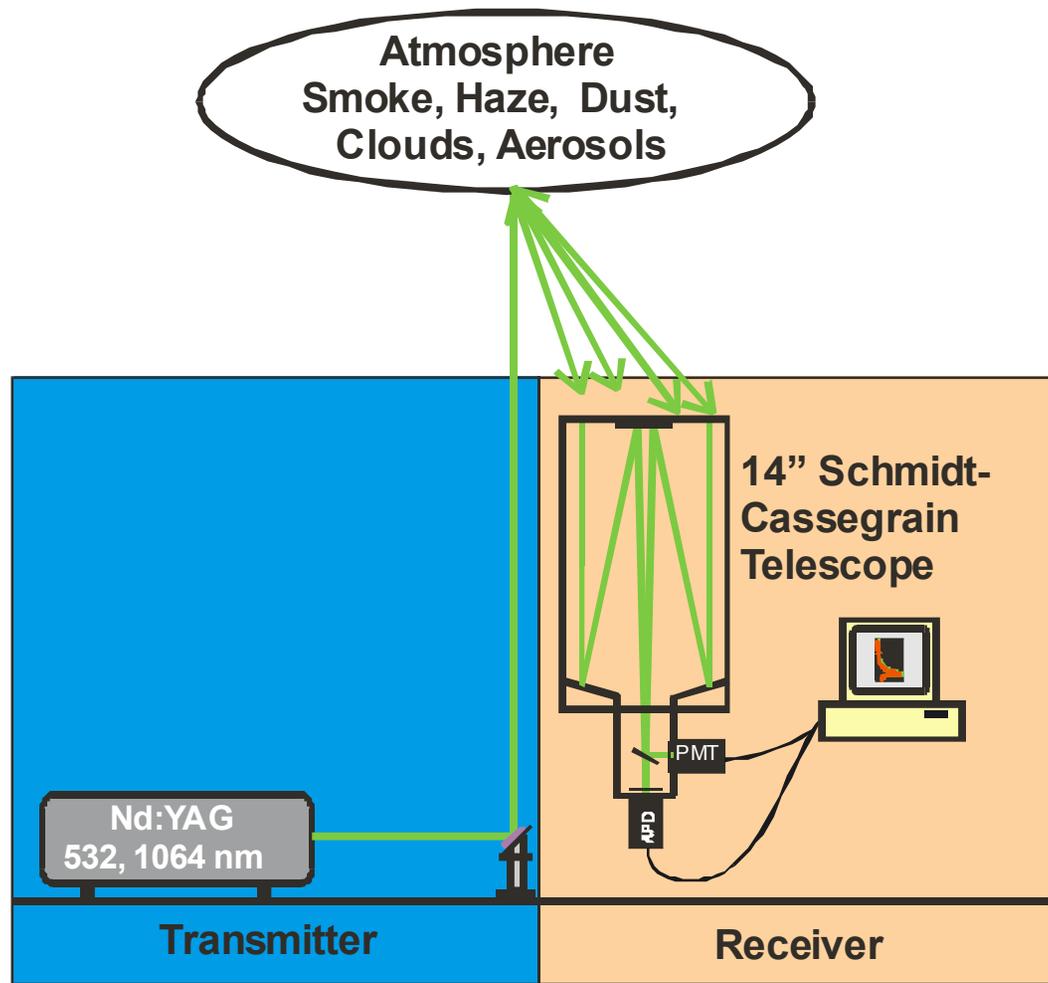
Daily posts

NASA satellite images, EPA data, etc.

Index & Links

Daily posts from 3.5 years
~ 35,000 visitors per month, including universities, EPA, NASA, NOAA, & States, and general public

Elastic Lidar Facility (ELF)



<http://alg.umbc.edu/REALM>



Whitepages HR PS Finance Retriever Blackboard ComcastMail NSPIRES Confluence NASA X.500 The Goddard Library
Windows Me... Welcome to the REALM Data Ce...

January 2007

Sun	Mon	Tue	Wed	Thur	Fri	Sat
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December 2006

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November 2006

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OCTOBER 2006

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SEPTEMBER 2006

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AUGUST 2006

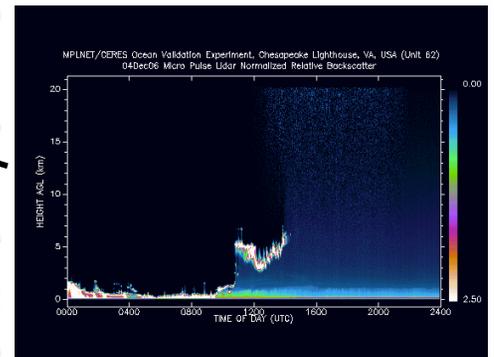
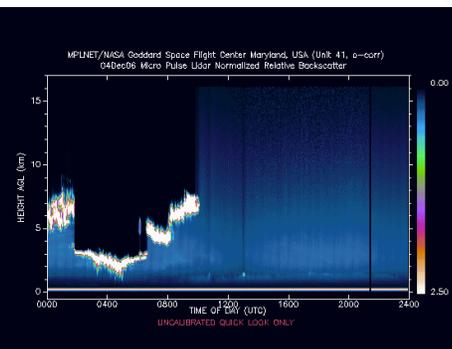
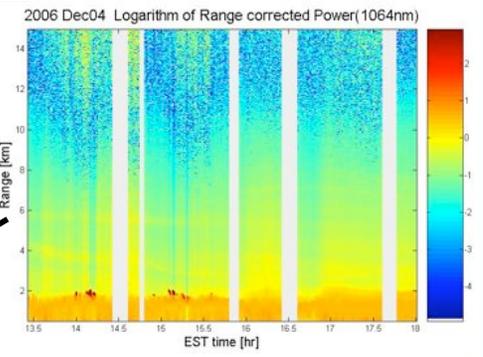
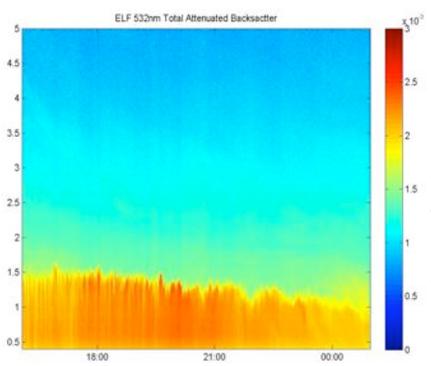
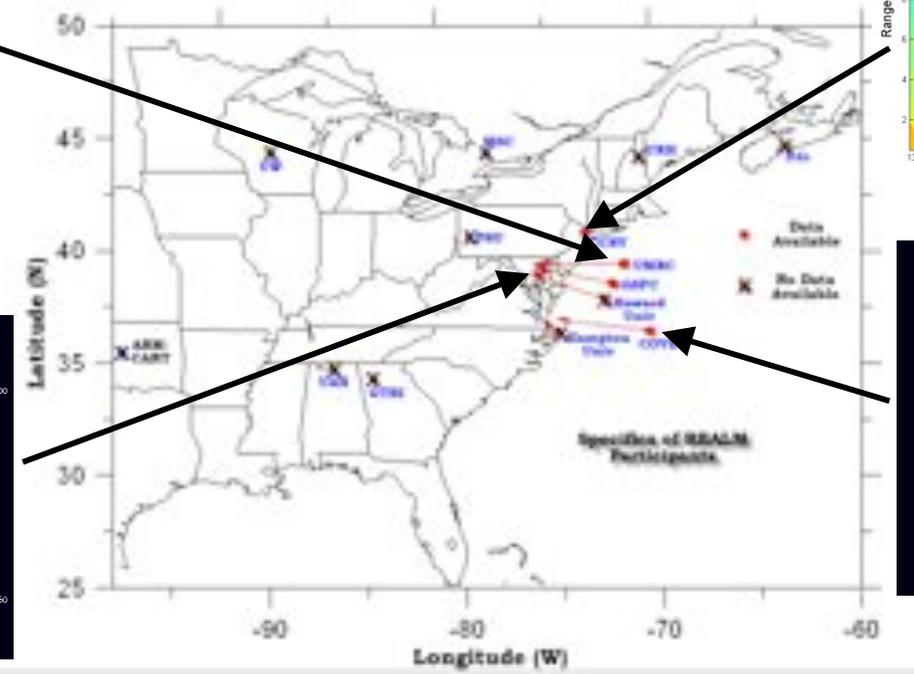
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REALM DATA CENTER



Date for: December 4, 2006

Click on a REALM Participant for their LIDAR data.



NASA Three-Dimensional Air Quality System (3D-AQS) Project

- Integrate operationally NASA satellite sensor and lidar data into EPA's air quality data systems: AQS/AirQuest, AirNow
- Provide greater accessibility and usability of satellite and lidar data to all users of these systems: IDEA, Smog Blog, REALM
- Develop visualization tools in horizontal and vertical dimensions for forecasting and retrospective analysis



Battelle



Integrated System Solutions for 3-D AQS Impacting Air Quality & Public Health

Sun-Earth Observations and Models for Predictions/Assessments/ Forecasts

Observations

Terra/Aqua
 MODIS
 AIRS
 LIDAR
 REALM
 MPLNet
 GOES
 GASP
 Aura
 OMI
 CALIOP
 CALIPSO
 AERONET

Models

NOAA
 Hysplit

 LaRC
 modified
 IMPACT
 trajectory
 model

IDEA

3D-AQS

USAQ
Weblog

Partnership Area

Decision-Support Tools

- AIRNow/AQS-EPA/NOAA**
- Increase synoptic data for PM_{2.5} forecasters
- AQS/AIRQuest (EPA)**
- Multi-dimensional aerosol related data and analyses:
 - Assess general state of air quality and trends
 - Assess progress of SIPs and compliance
 - Waivers to air standards
 - Air quality rule development
- NEPHTN-PHASE (CDC)**
- Produce better AQ maps through statistical models

Value & Benefits to Citizens & Society

Increase accuracy in AQ forecast: reduce poor air quality health impacts.

Increase knowledge in causes or poor air quality – leading to improvements in AQ and confidence in government.

Improved prevention initiative targeting.

INPUTS

OUTPUTS

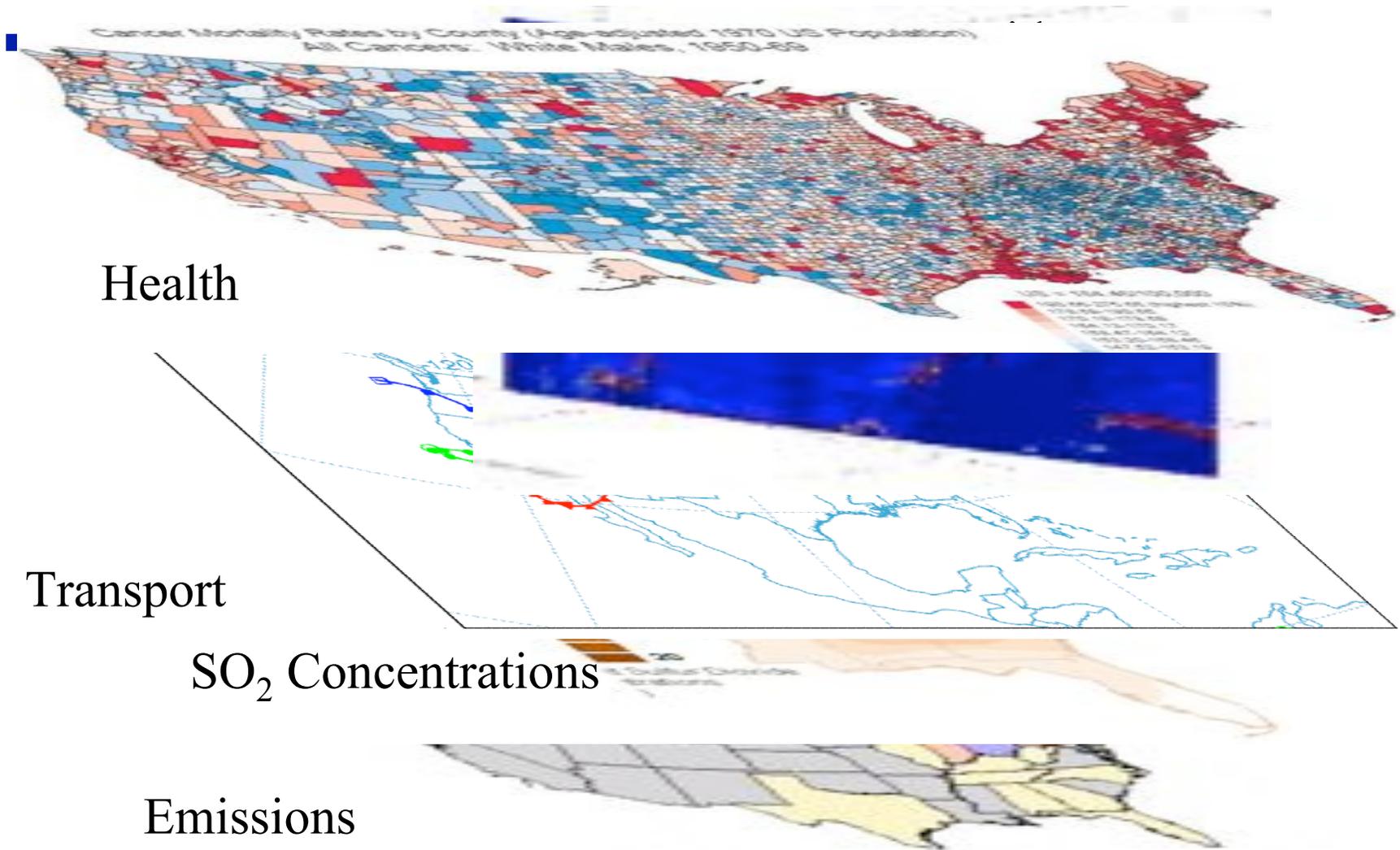
OUTCOMES

IMPACTS

NASA/NOAA/EPA/ UMBC/CIMSS/BMI

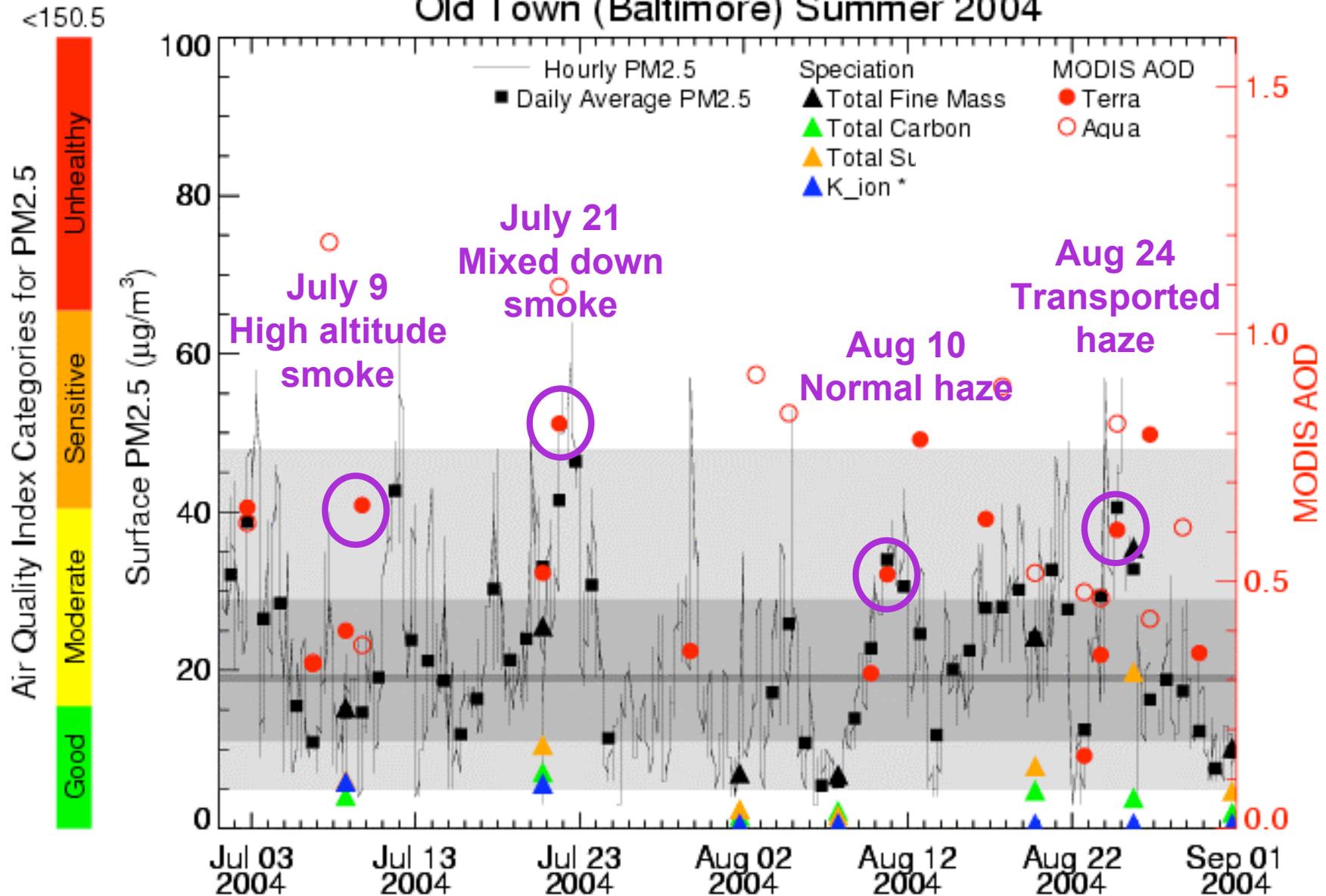
EPA/NOAA/CDC

3D-AQS integrates disparate datasets - our vision

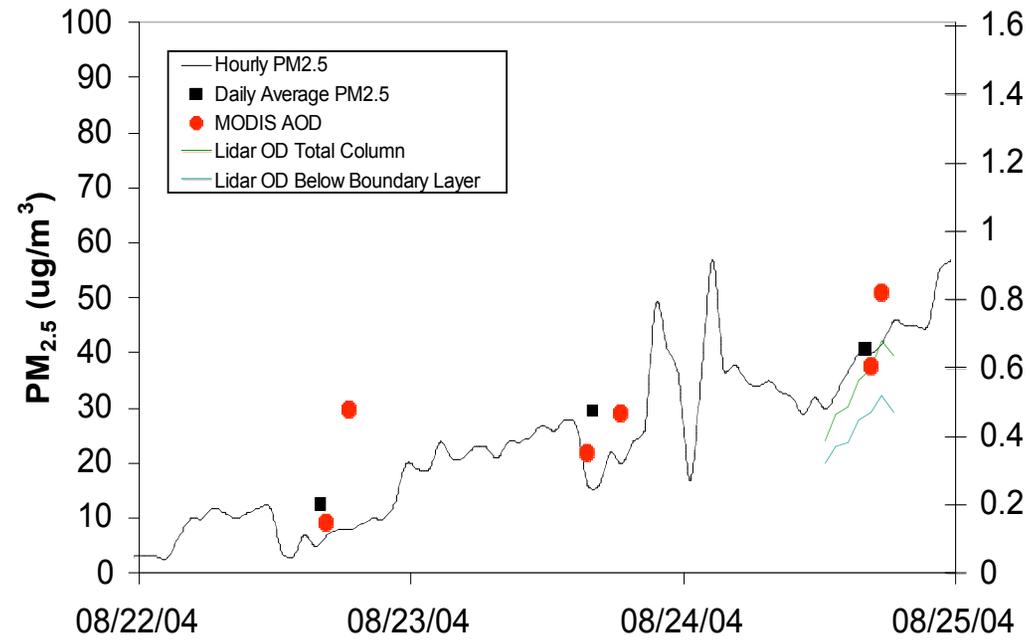


Baltimore, MD Summer 2004

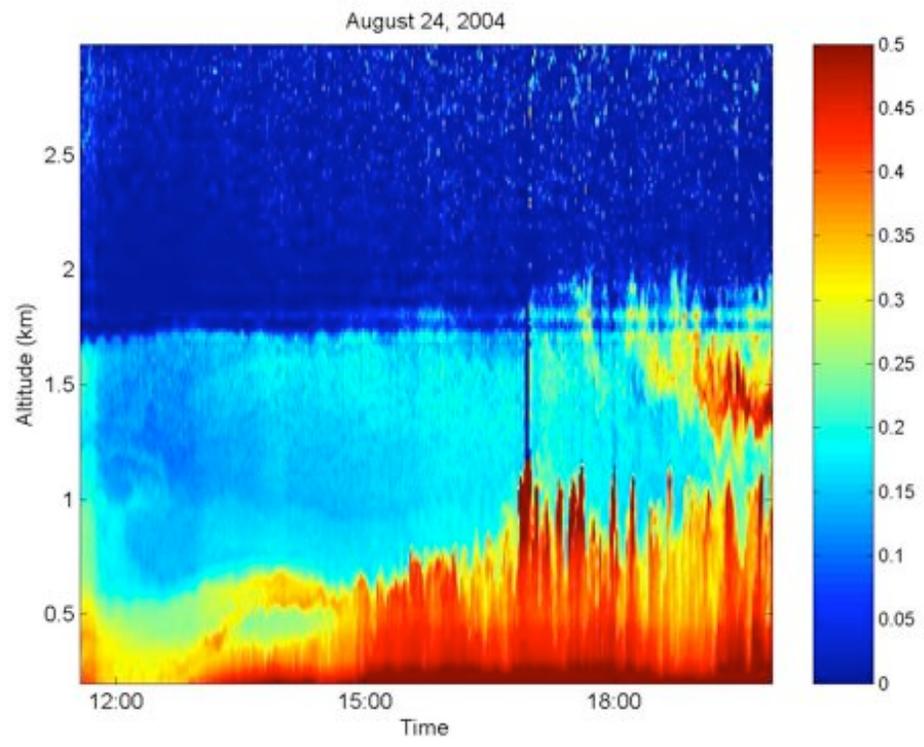
Old Town (Baltimore) Summer 2004



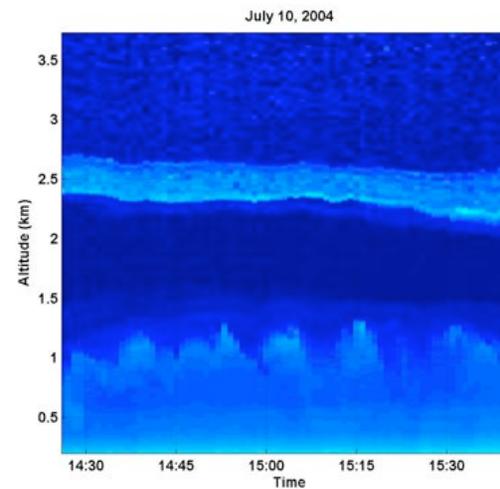
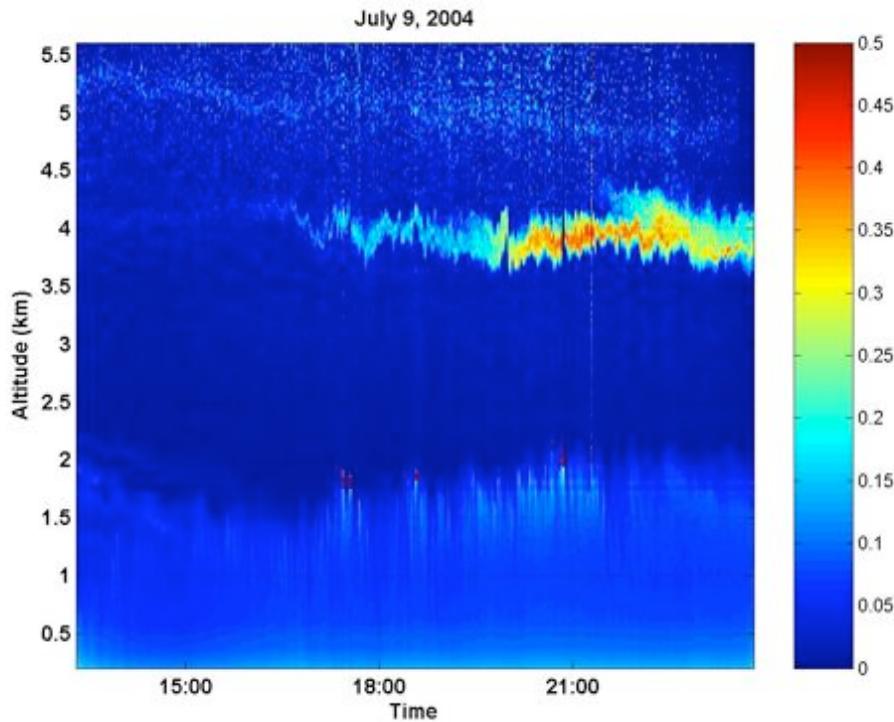
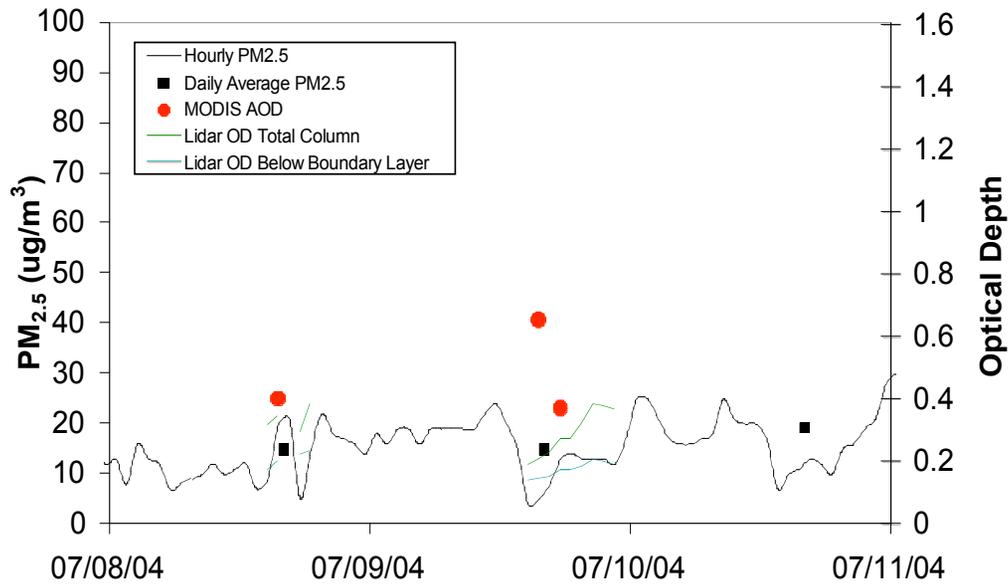
Sulfate transport to Maryland 24 August 2004



Optical Depth



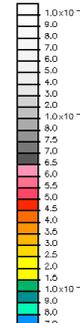
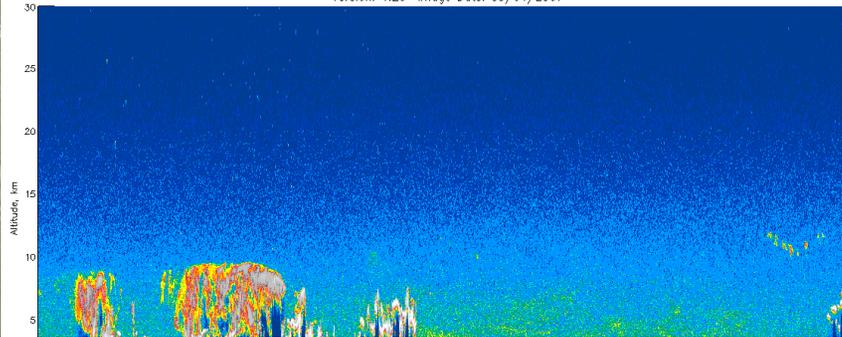
Alaskan Smoke over Maryland 9 July 2004



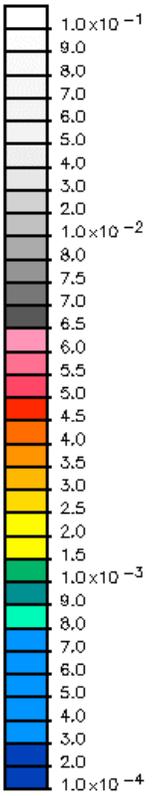
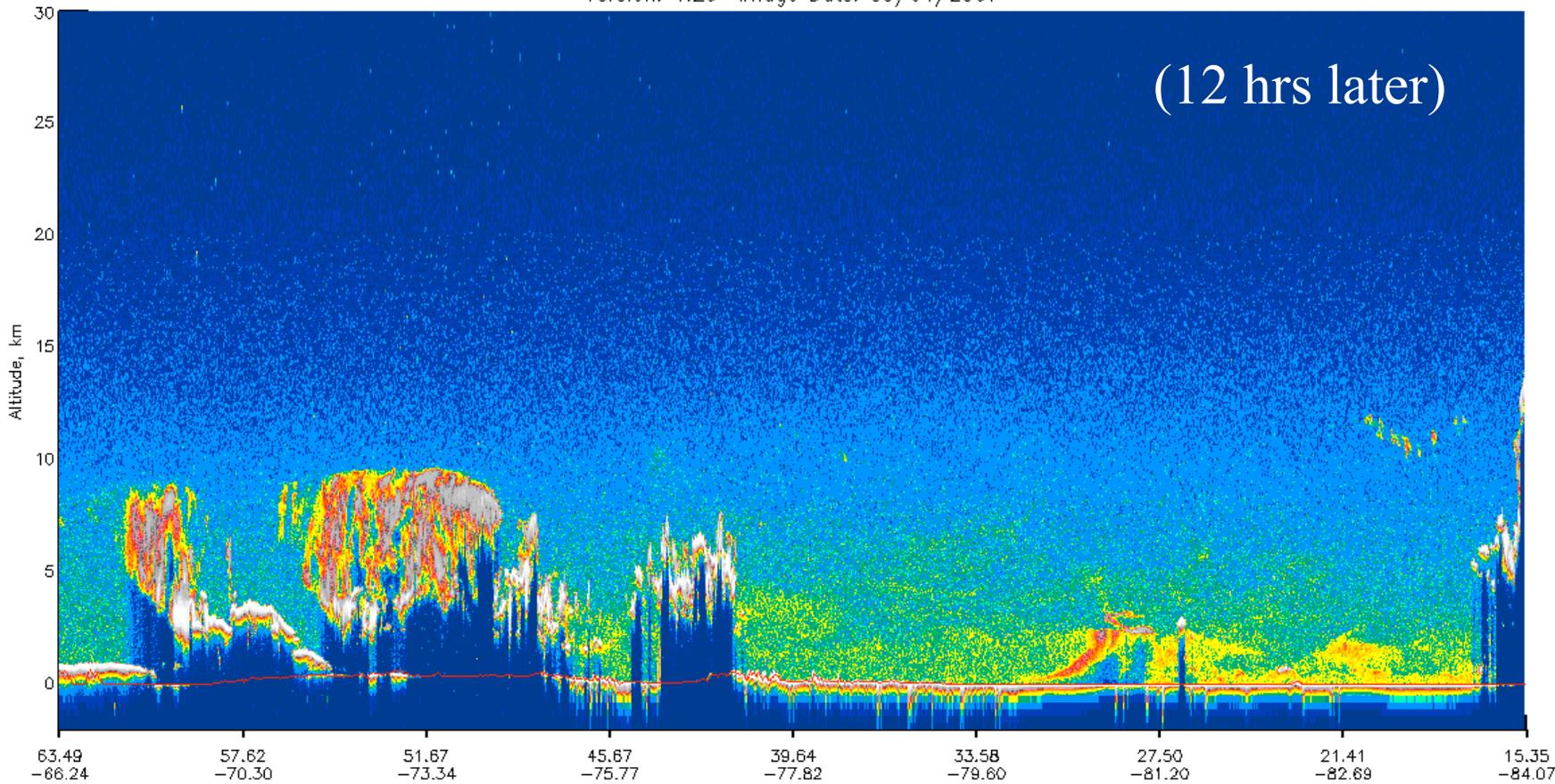
10 July 2004, am



532 nm Total Attenuated Backscatter, /km /sr Begin UTC: 2007-04-30 07:16:19.7861 End UTC: 2007-04-30 07:29:48.4331
Version: 1.20 Image Date: 05/04/2007

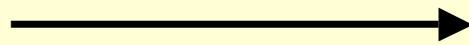


532 nm Total Attenuated Backscatter, /km /sr Begin UTC: 2007-04-30 07:16:19.7861 End UTC: 2007-04-30 07:29:48.4331
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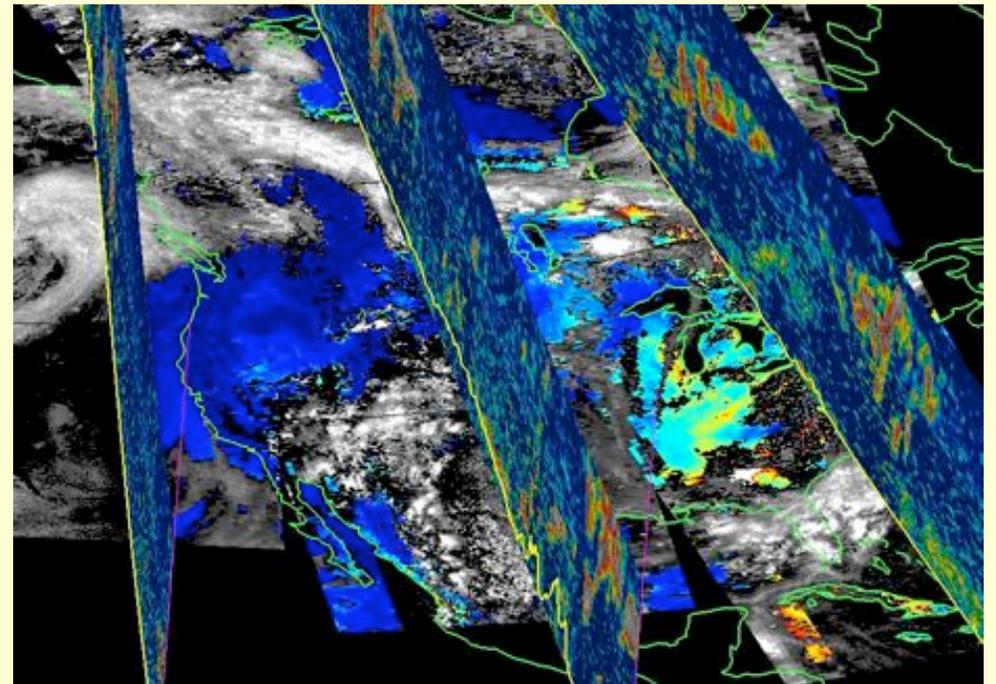
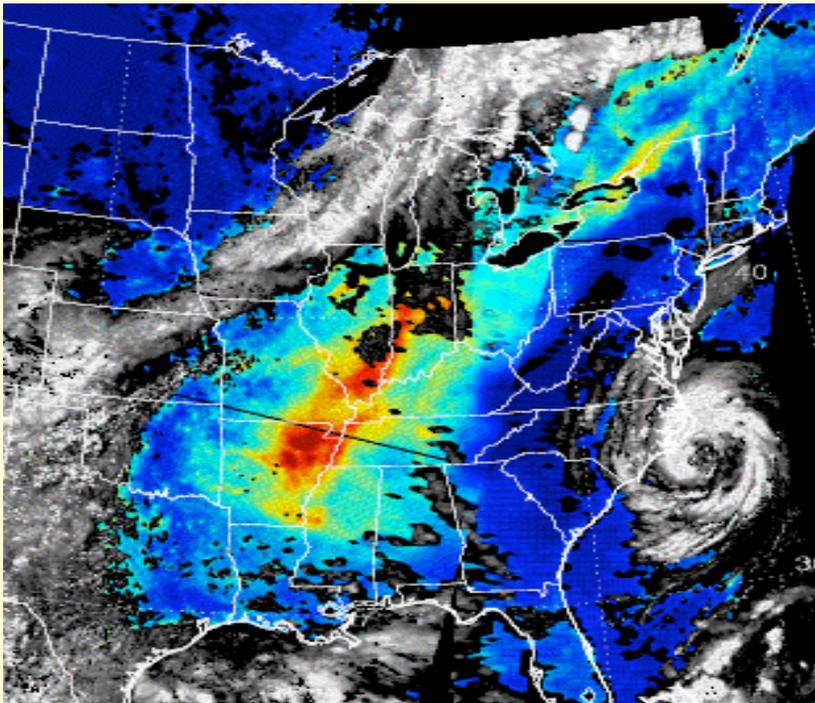


Direction of changes to the website

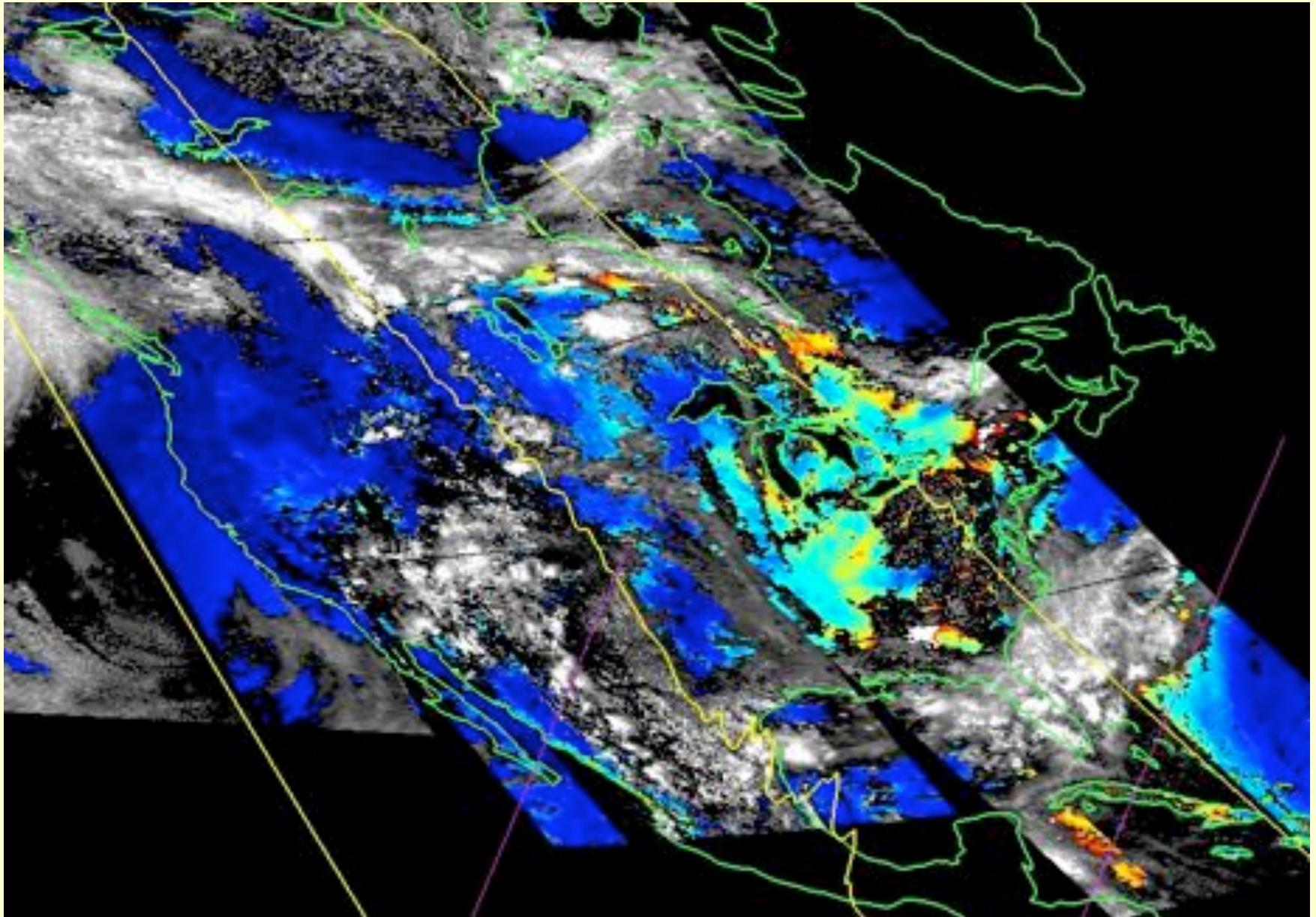
IDEA*

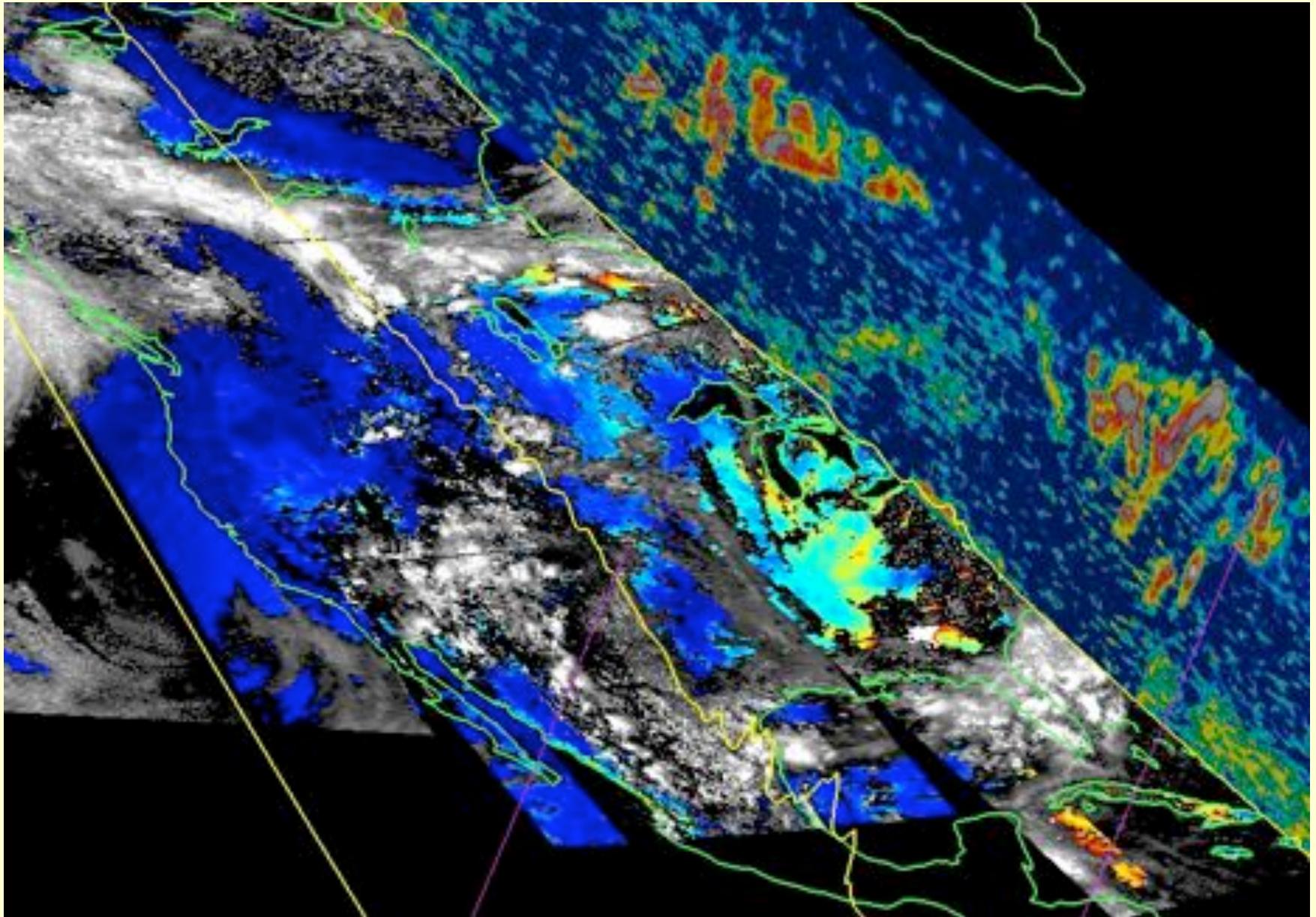


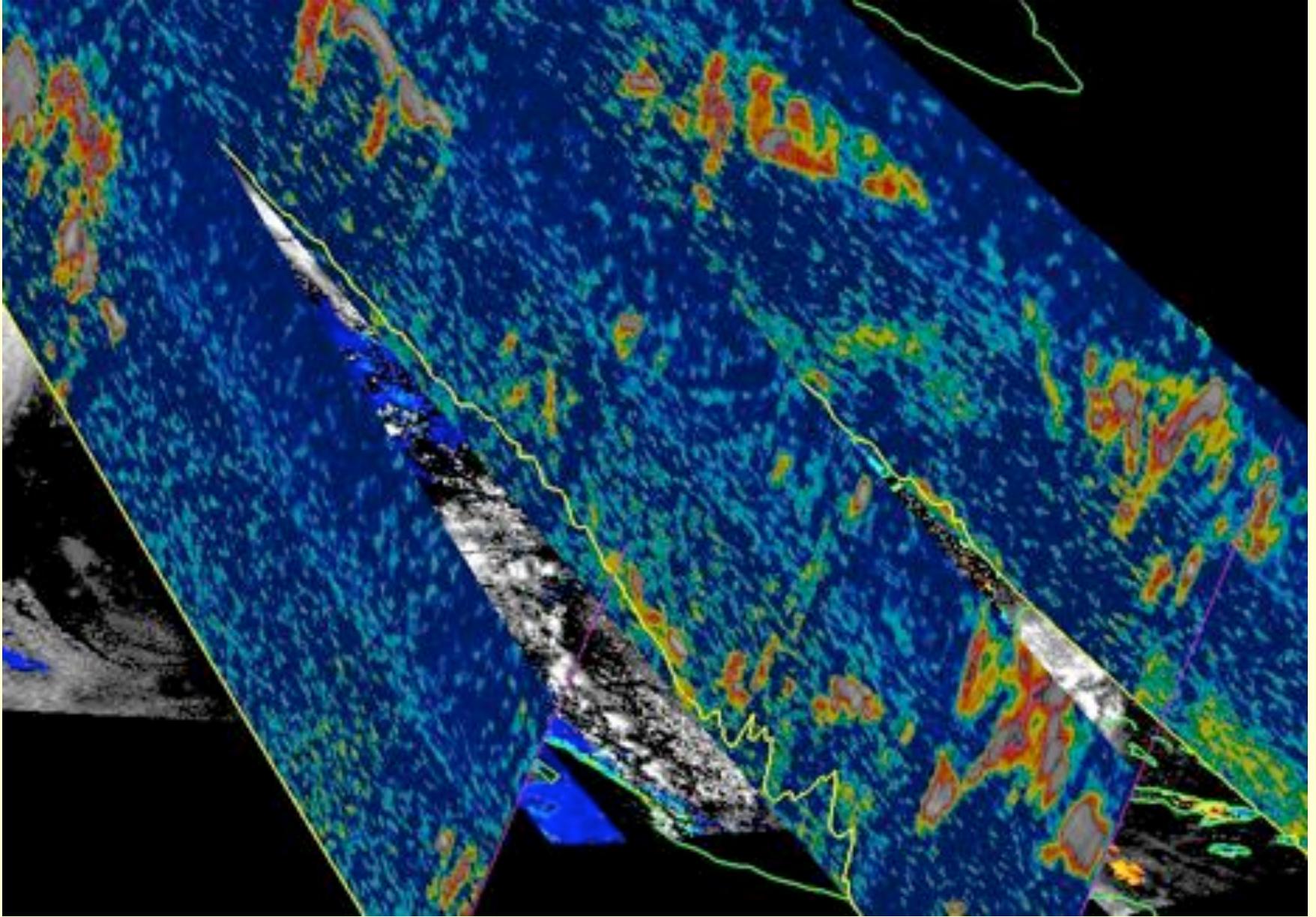
“3D-IDEA”

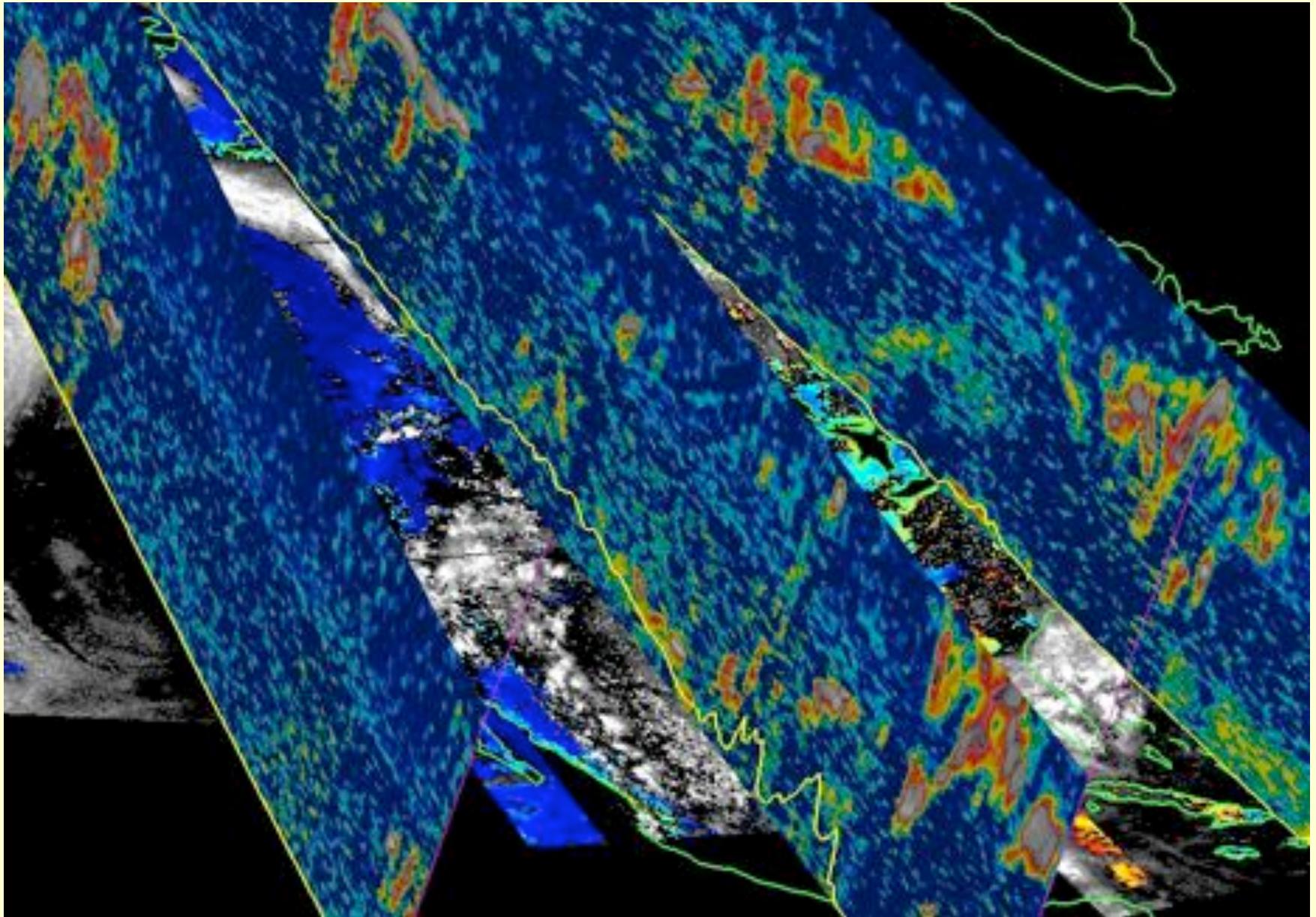


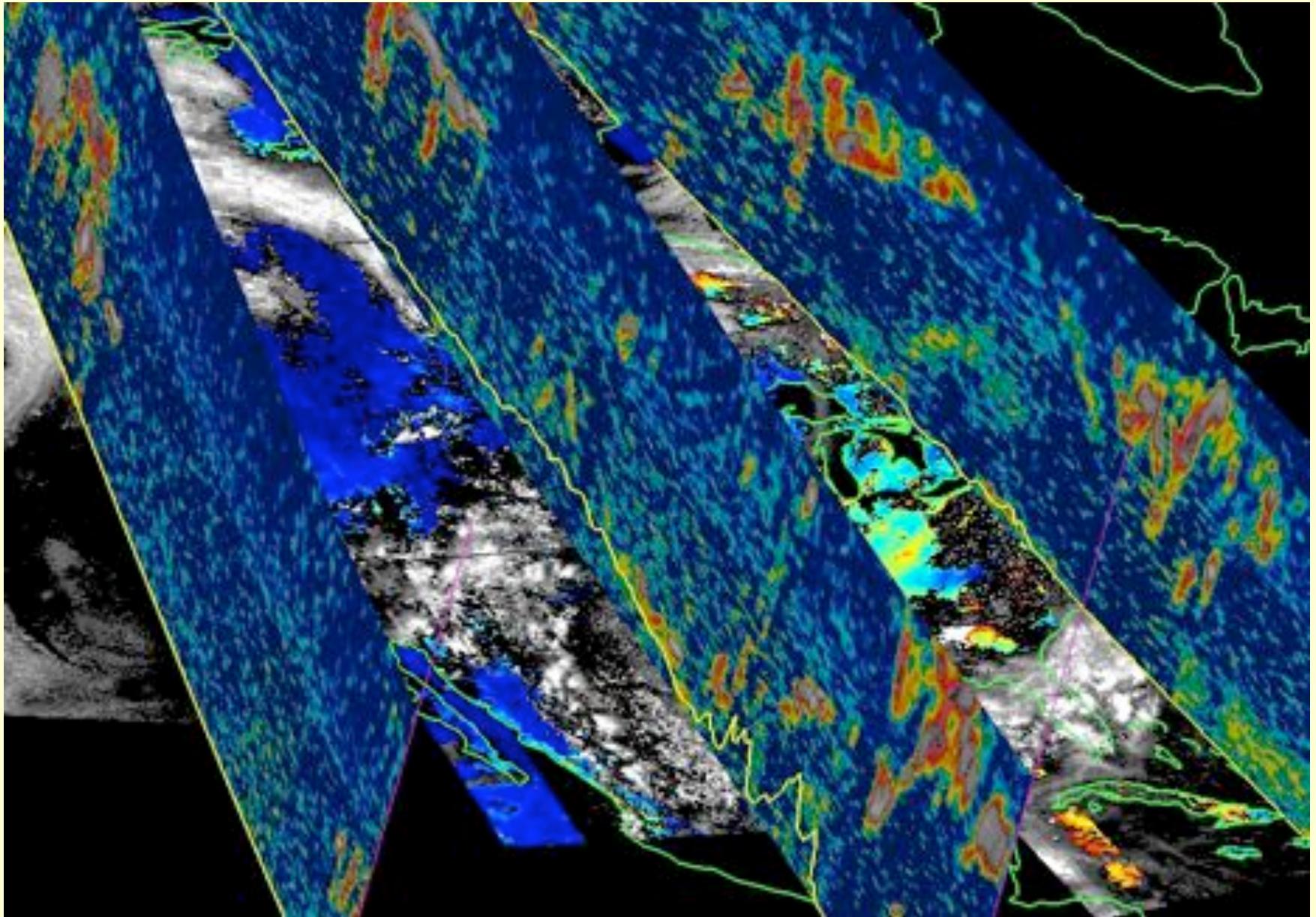
* Infusing satellite Data into Environmental Applications

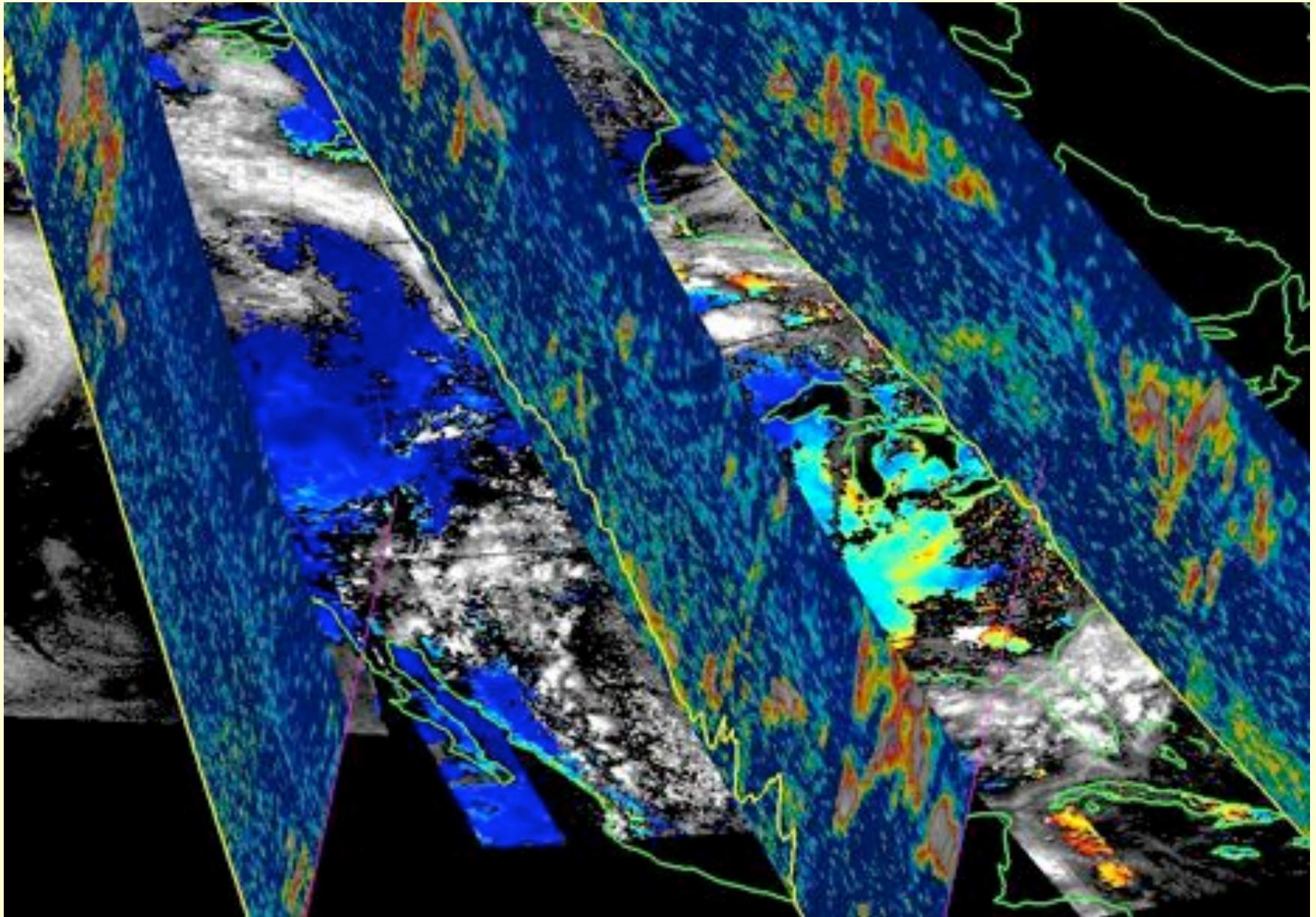


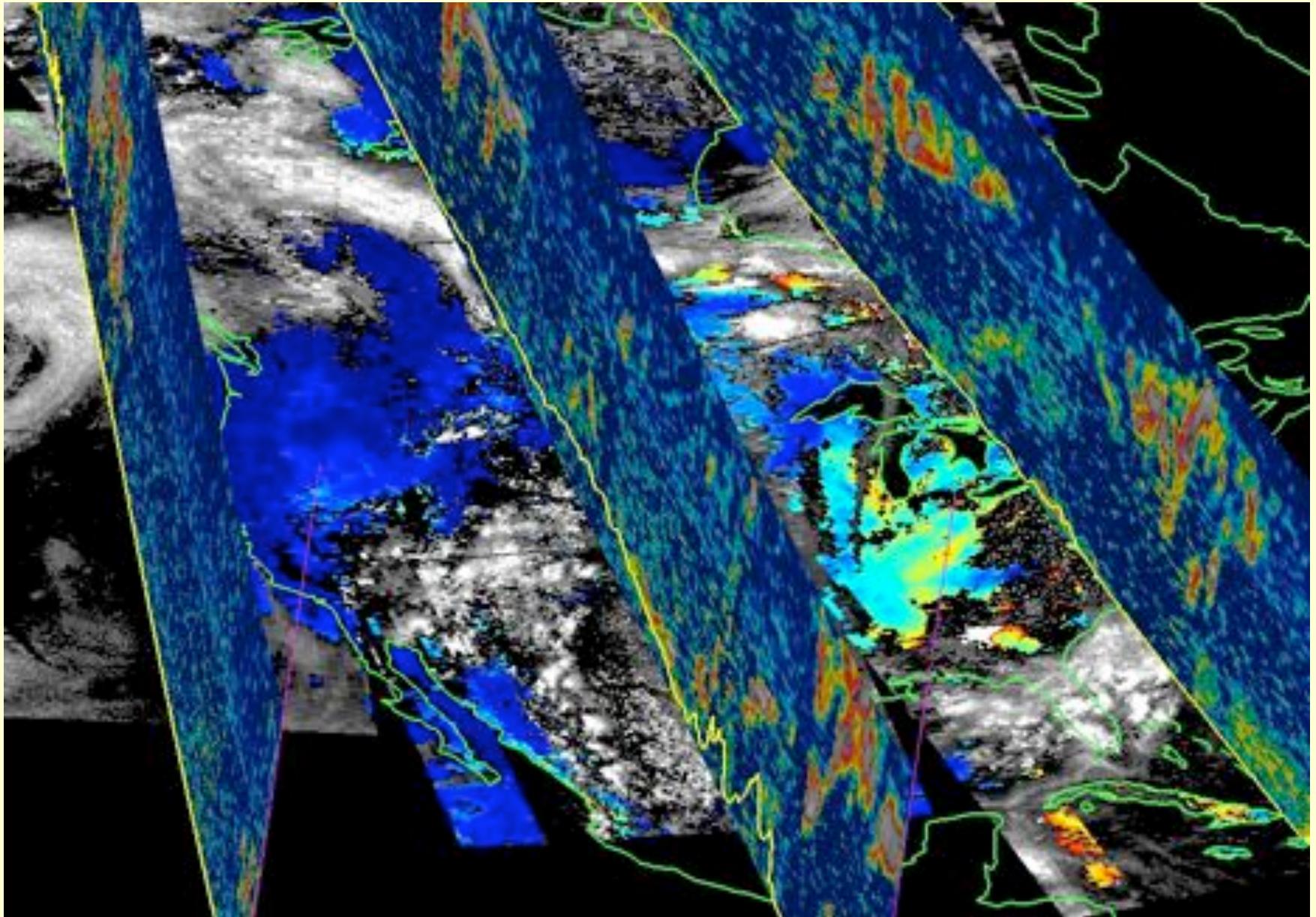


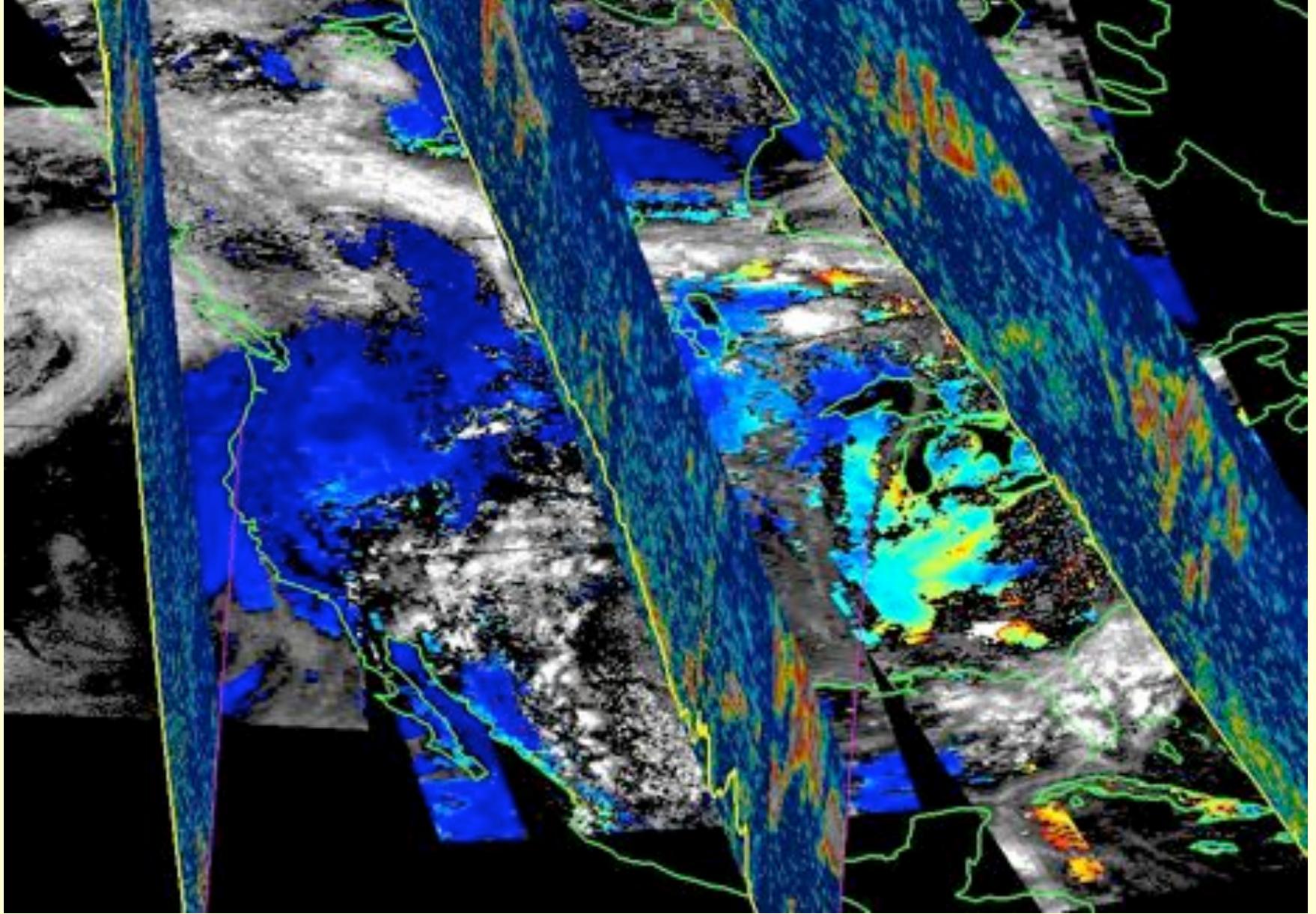


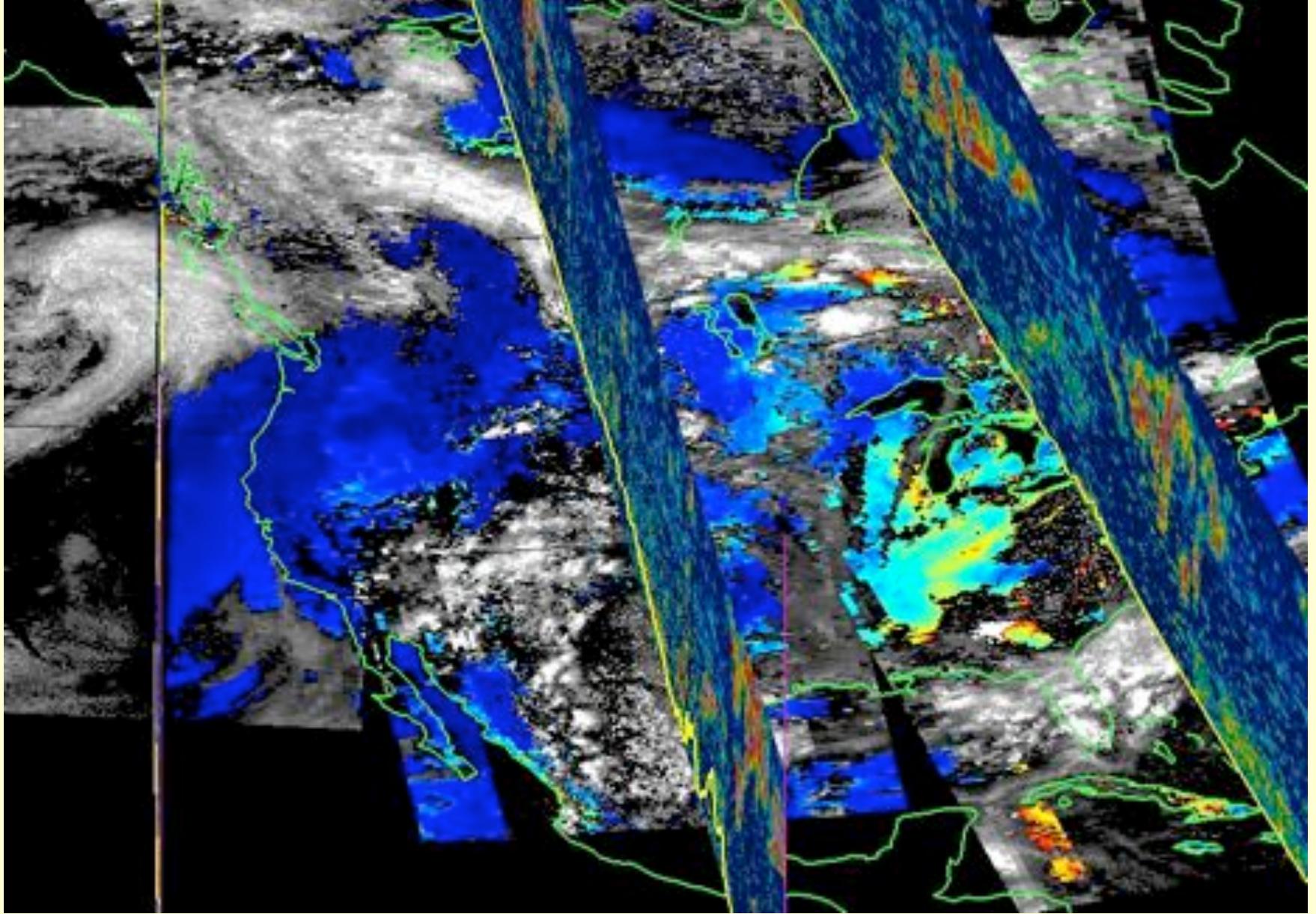


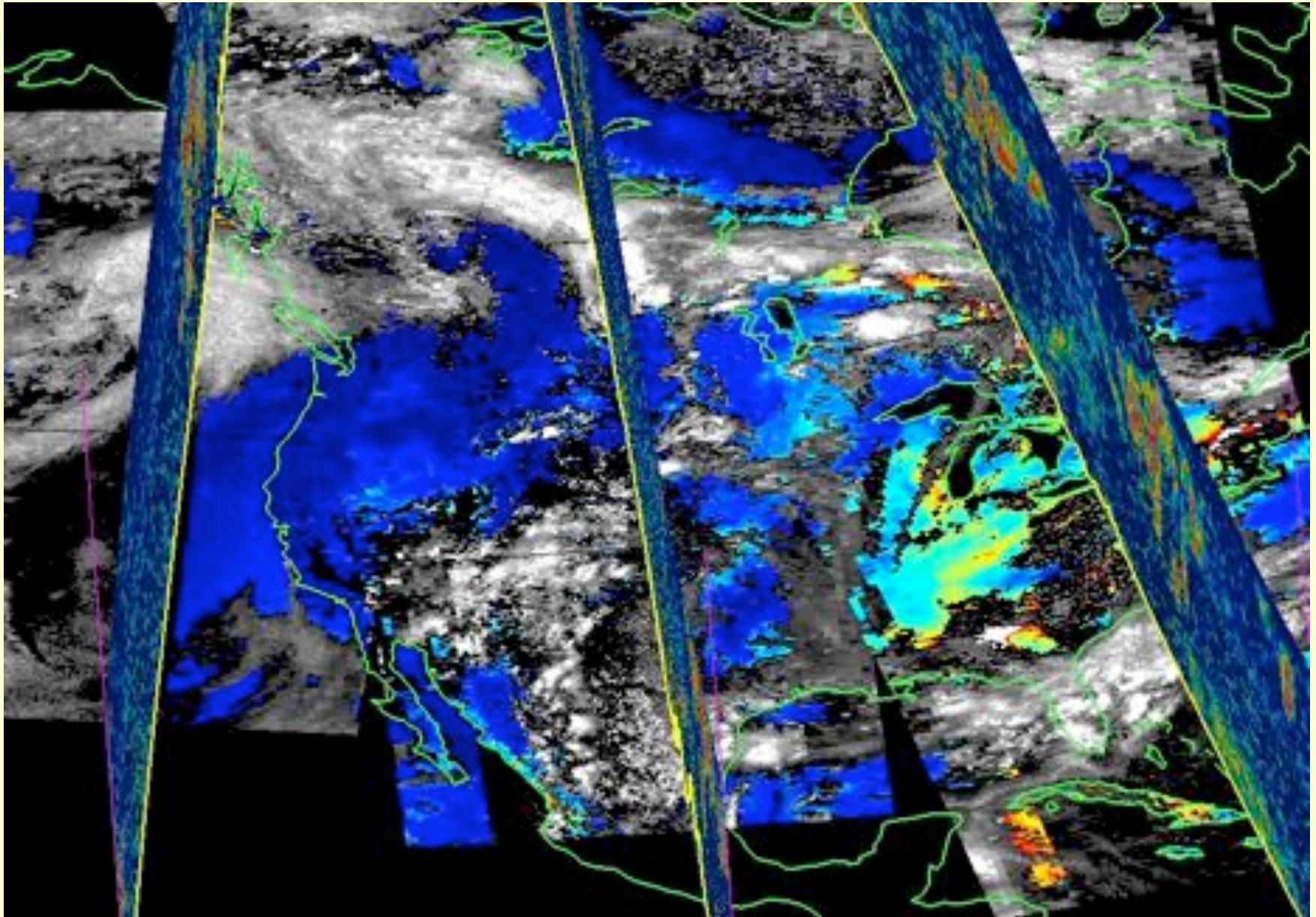


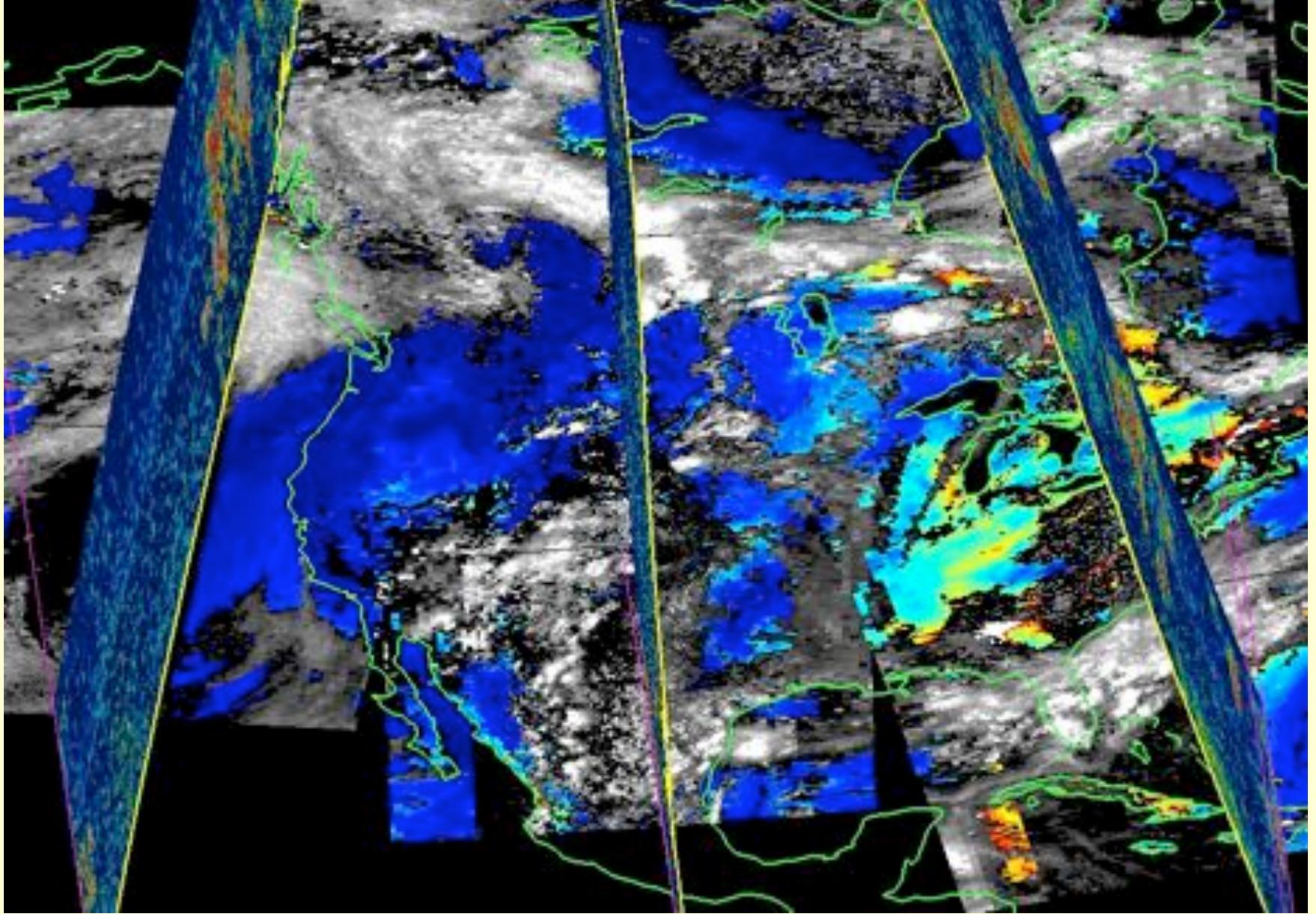


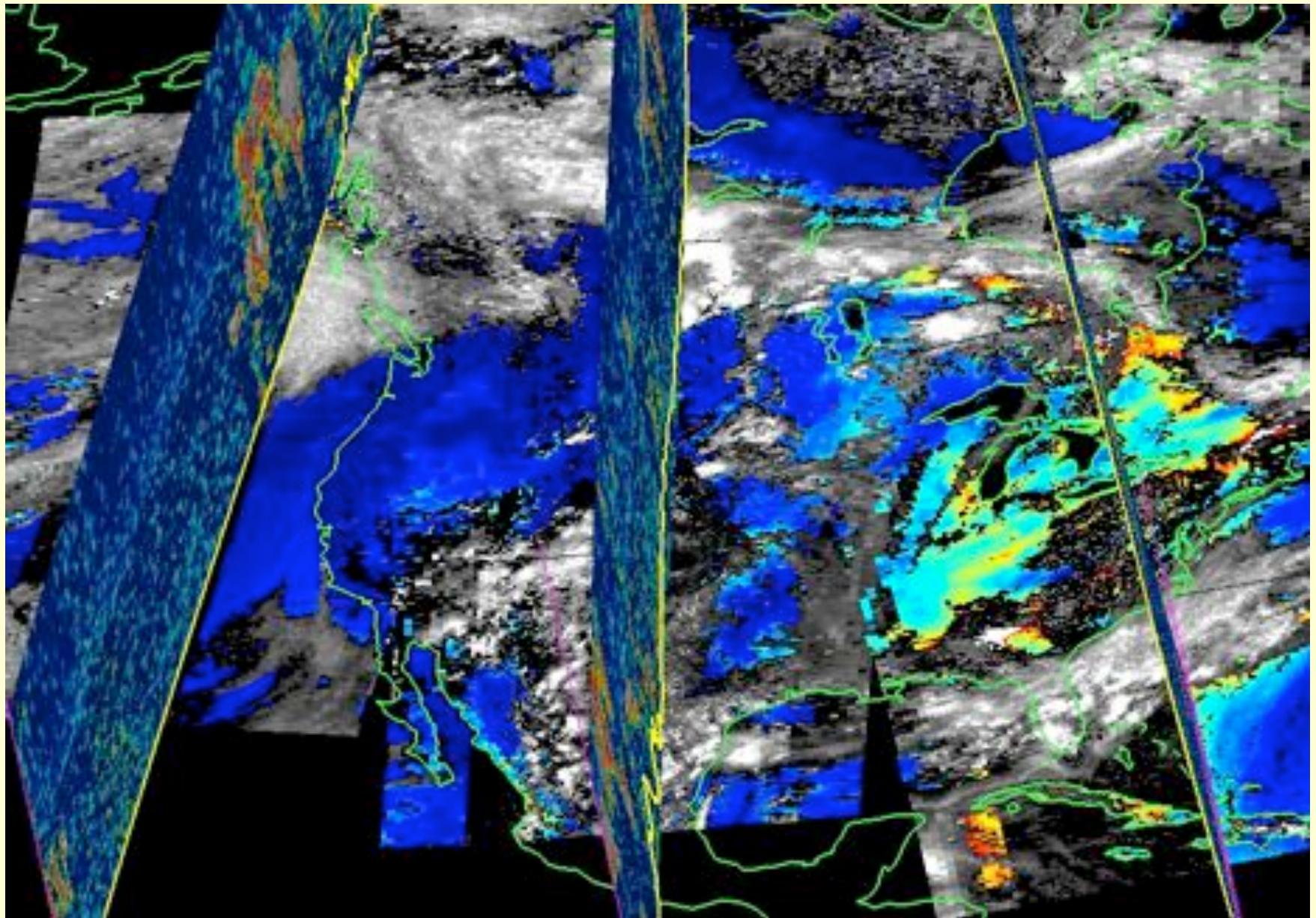


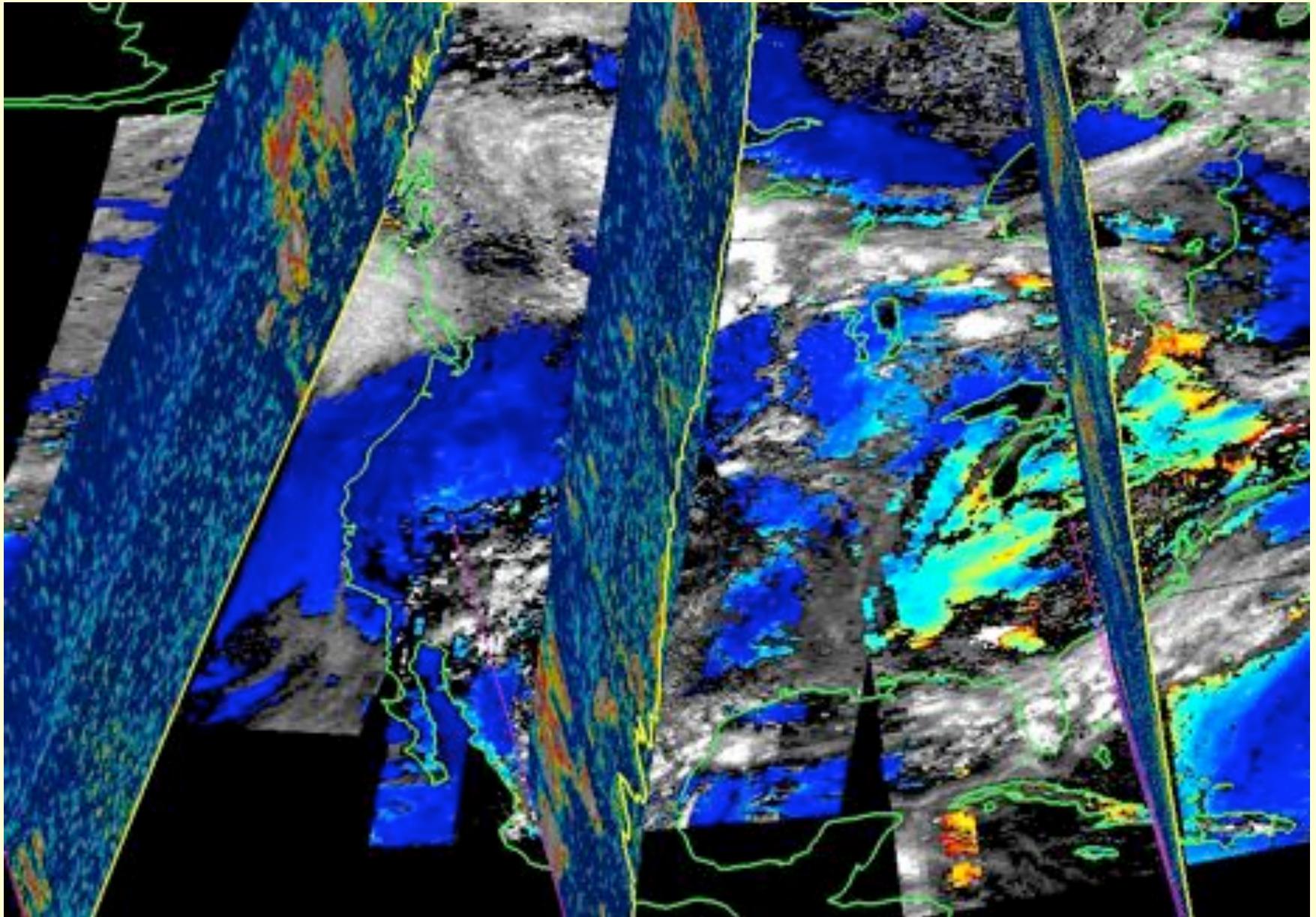


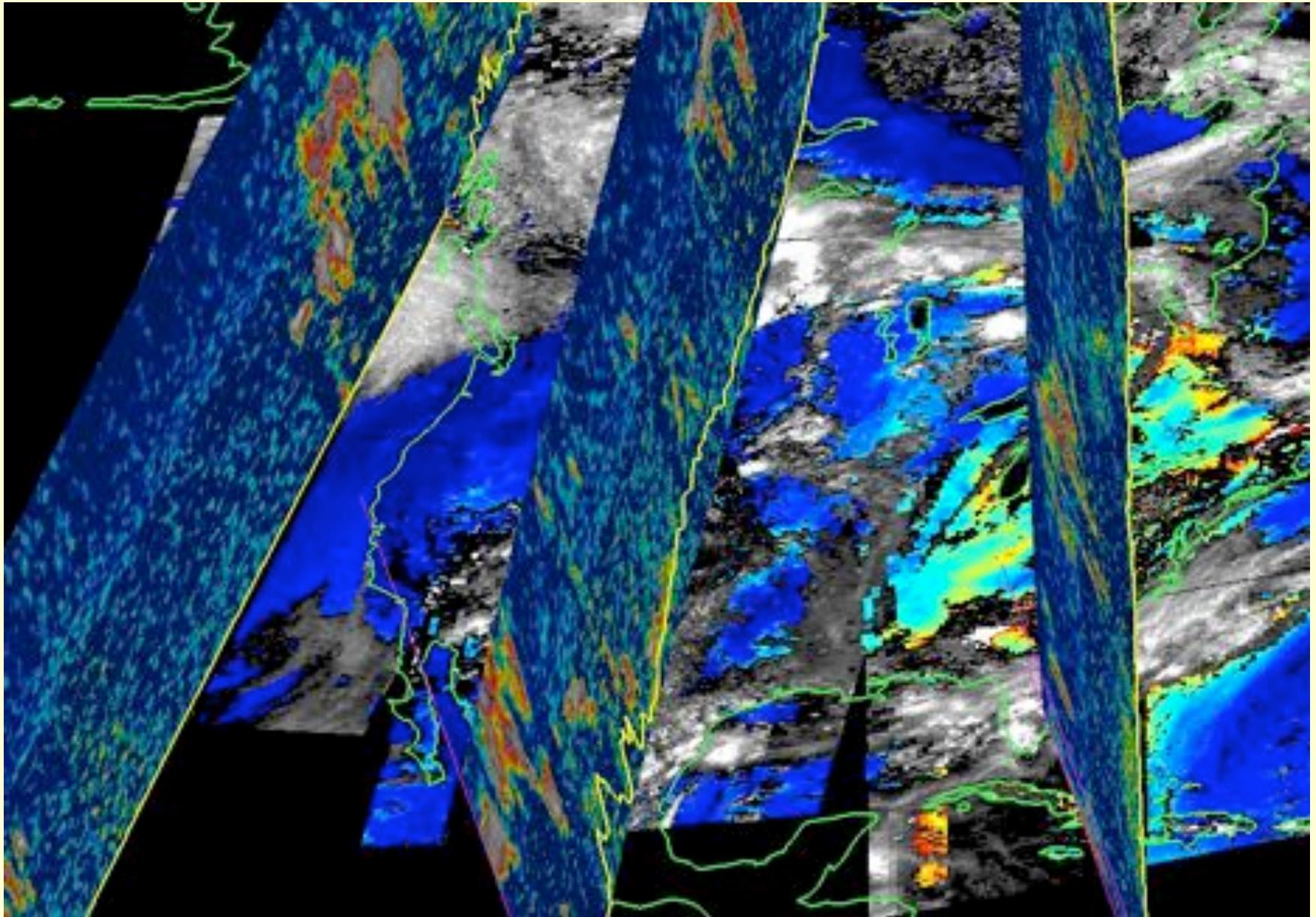


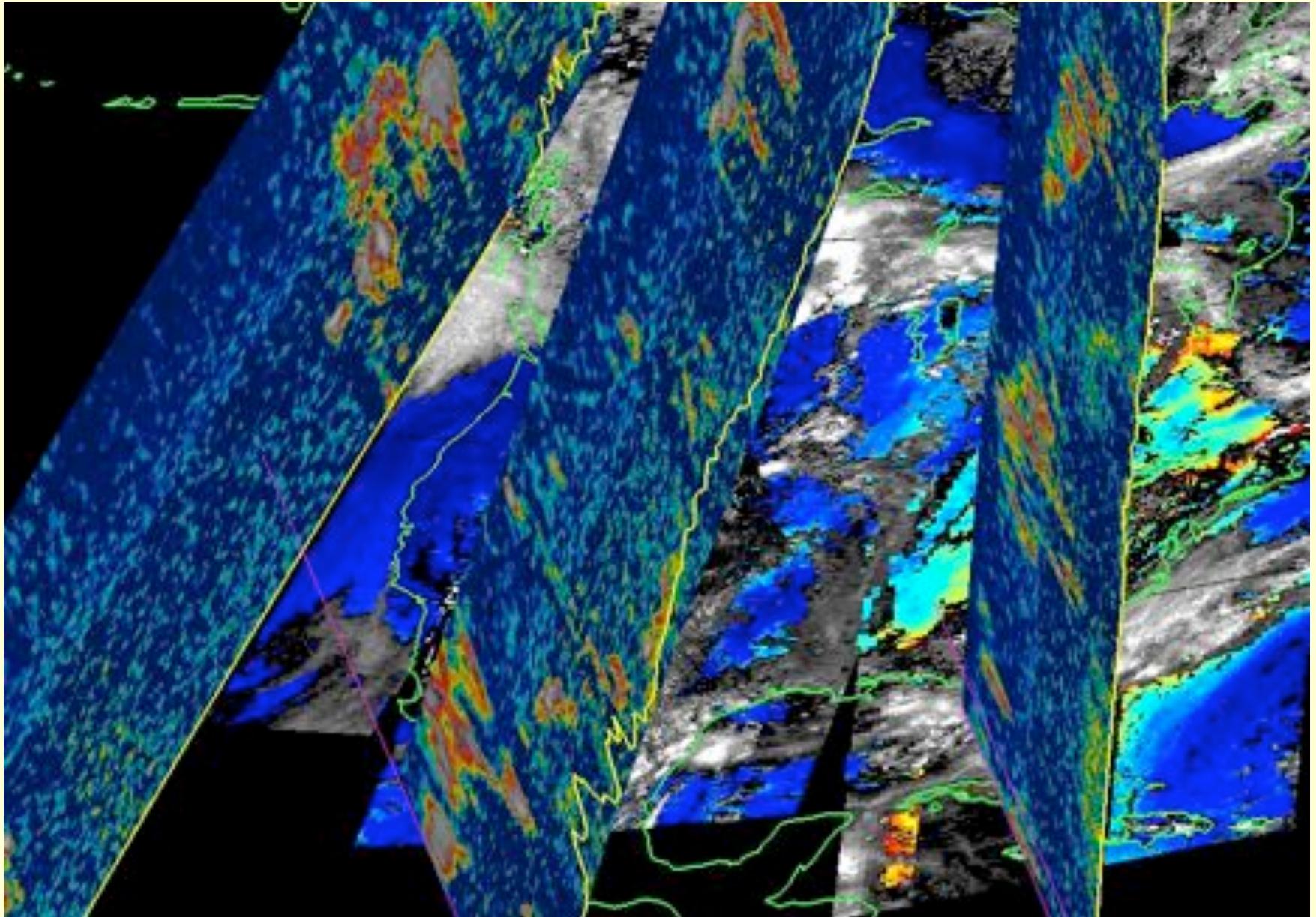


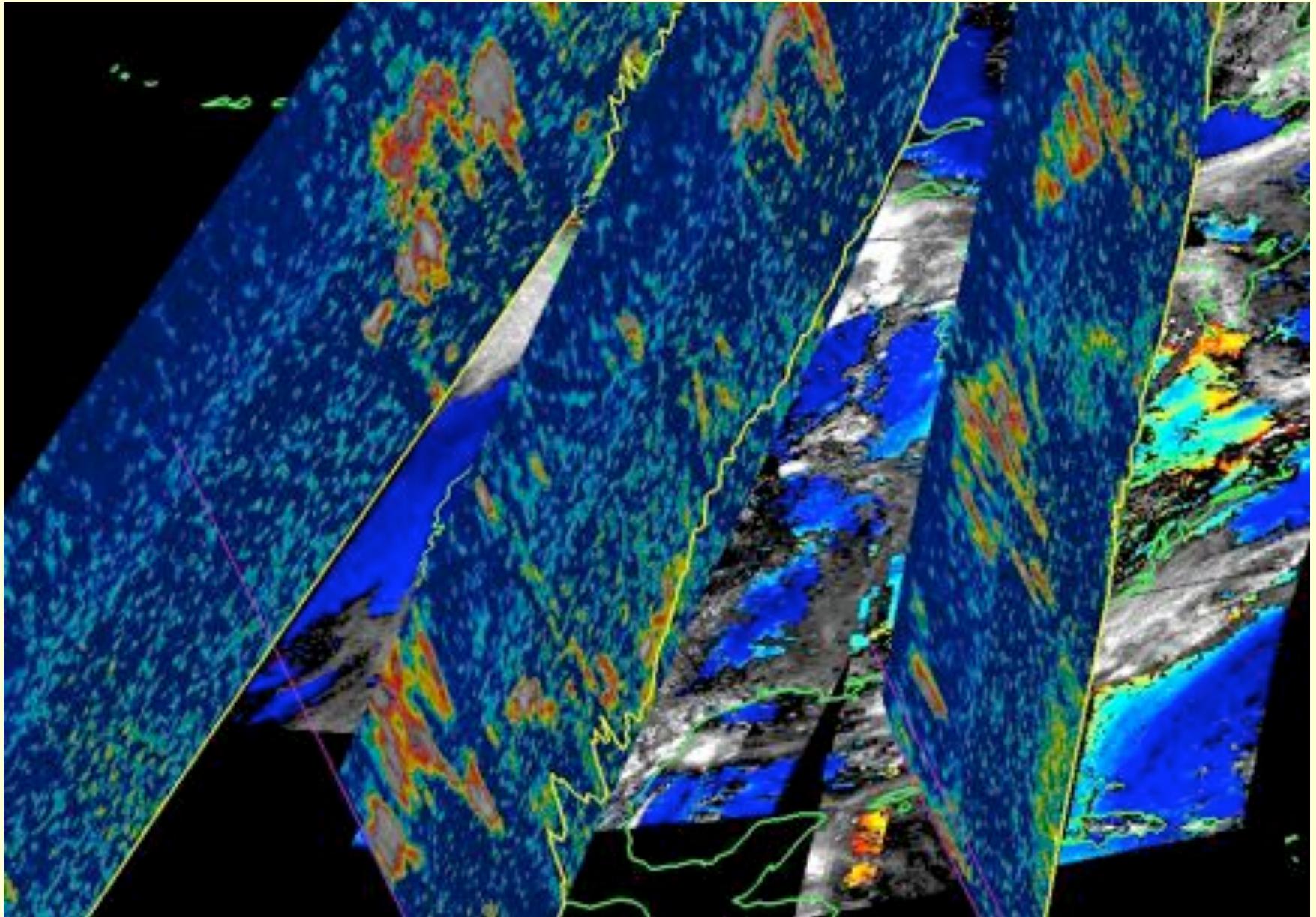


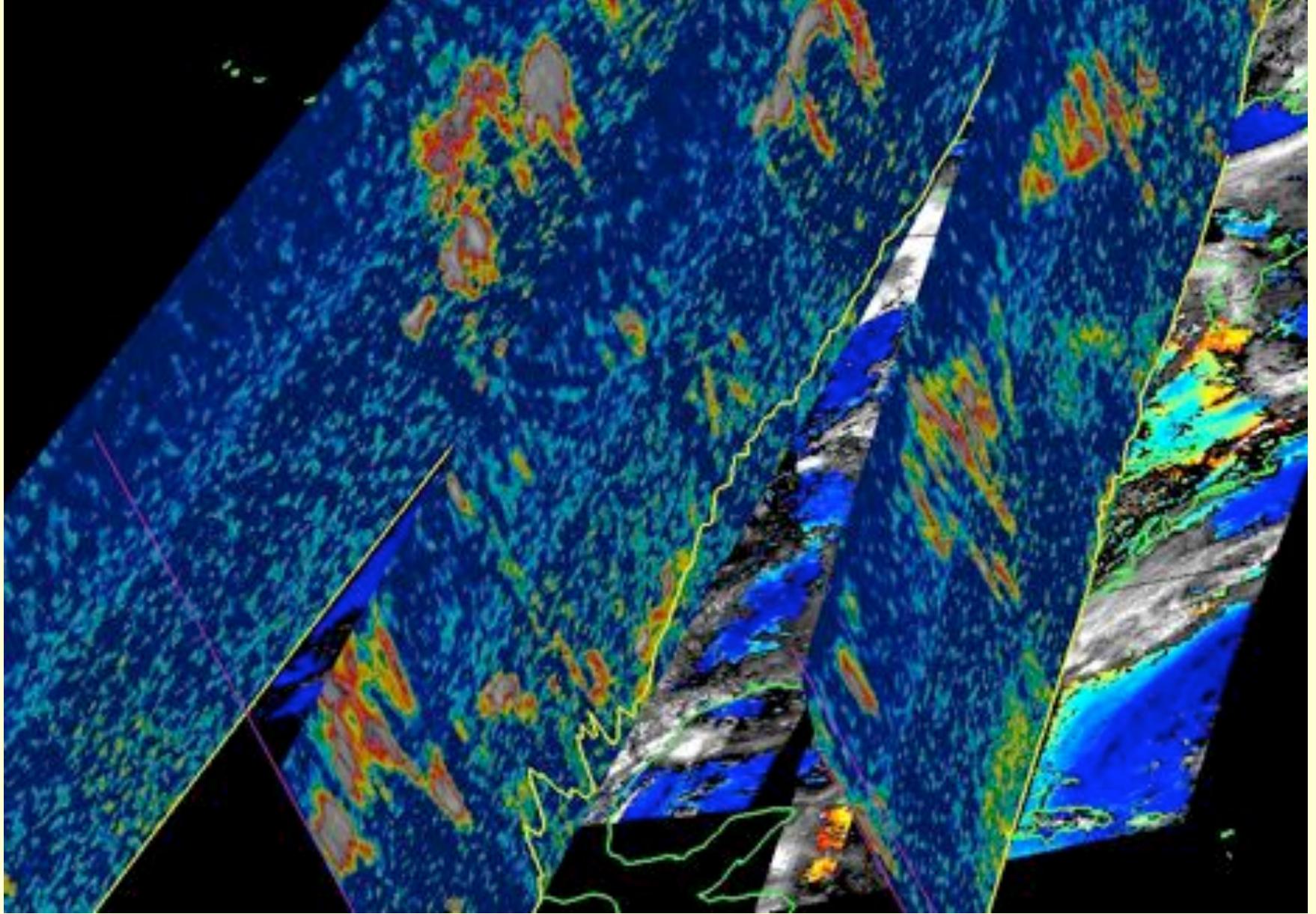


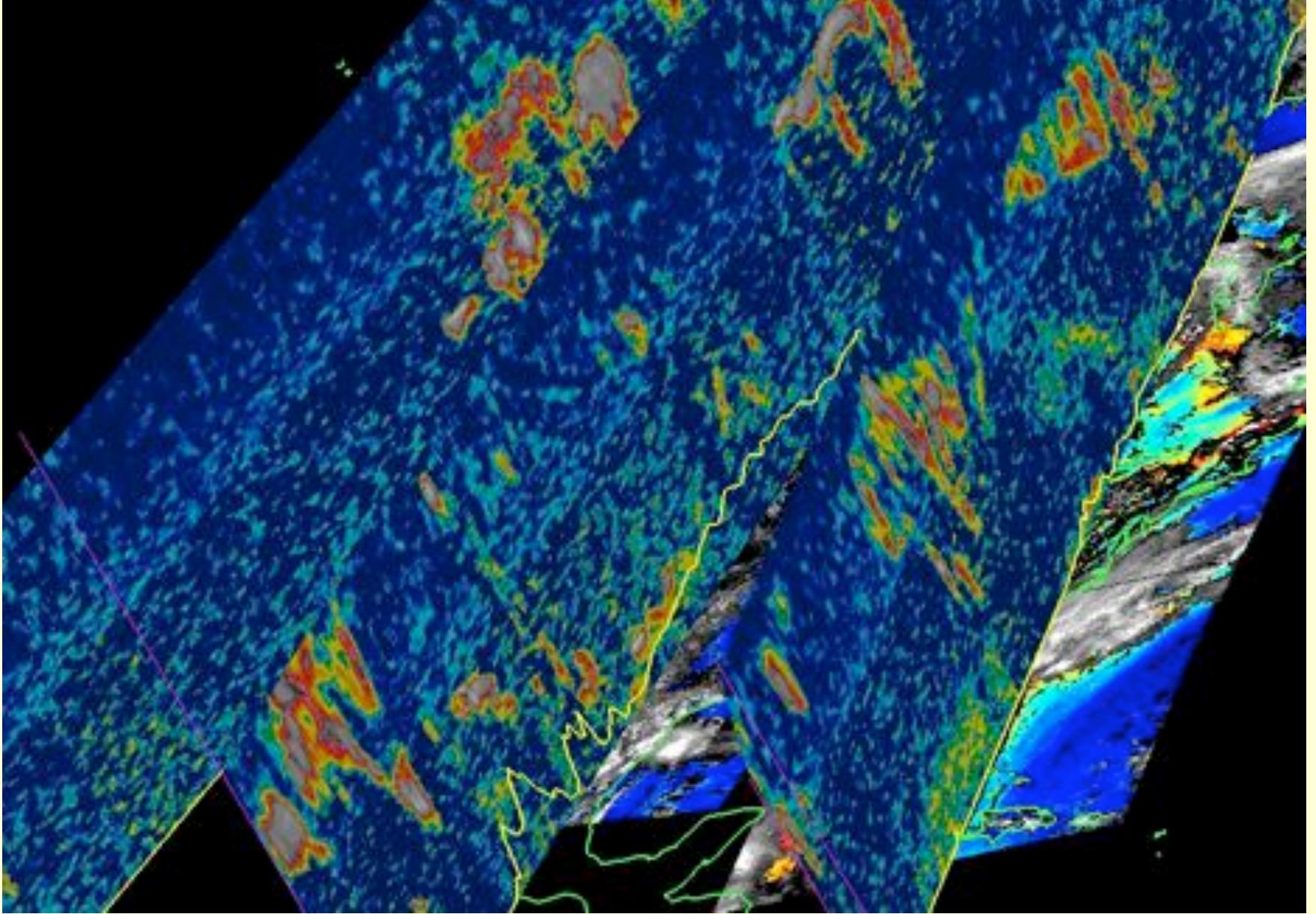












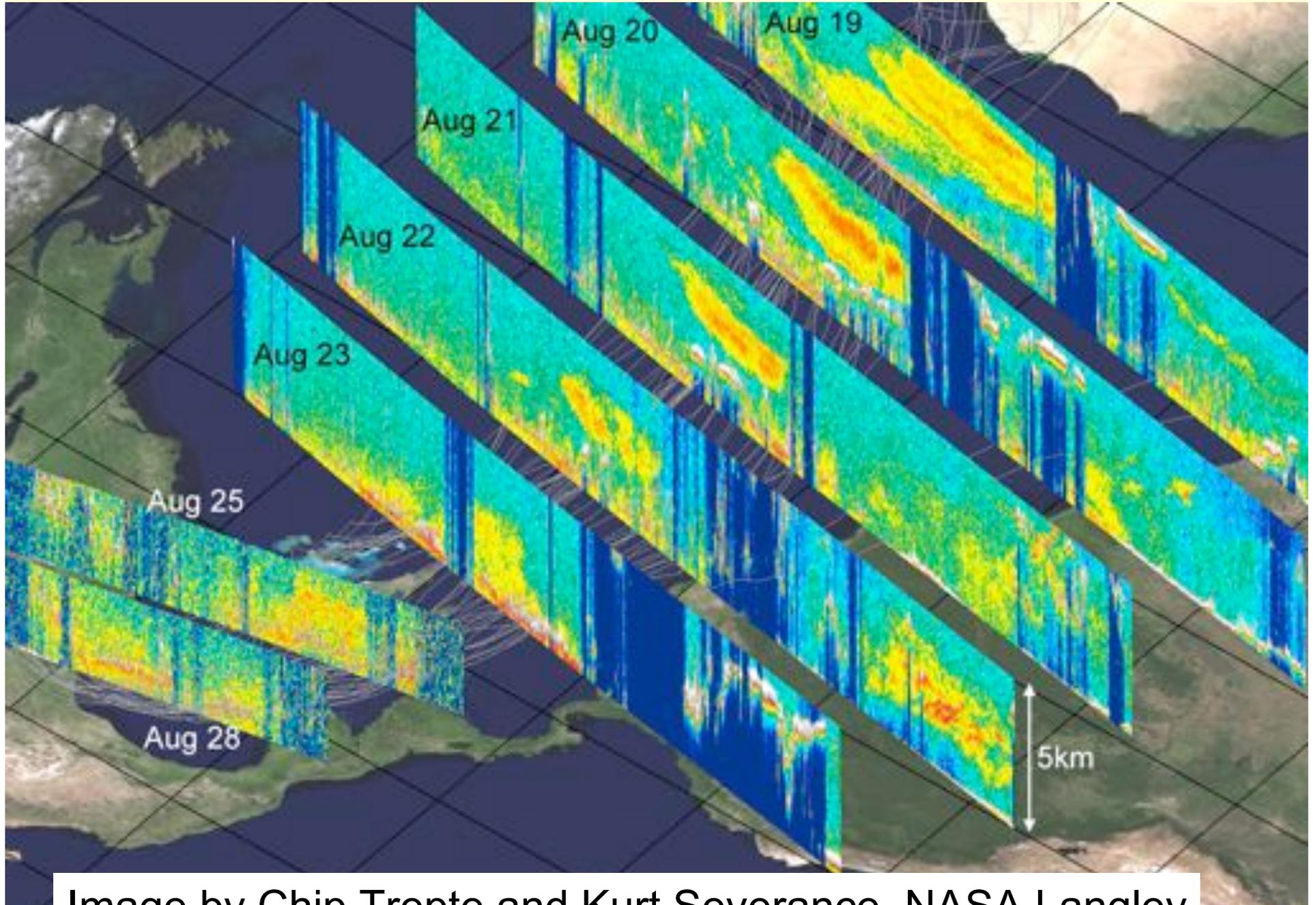


Image by Chip Trepte and Kurt Severance, NASA Langley

Progress of 3D-AQS Project

Progress

- Determined priority datasets:
 - MODIS AOD and PM_{2.5} monitor matched data
 - GASP AOD, AERONET AOD, LIDAR profiles and AOD
- Porting historical MODIS AOD-PM_{2.5} matched station data to AirQuest
- Started development of finer resolution AOD data (5x5km and 2x2 km)
- Started development of 3D visualization methods
- Transferring IDEA to operational NOAA environment
- Formation and interaction with end user committee

Timeline

- 2007-08: Evaluation of other sensors (OMI, AIRS) for integration into AirQuest. Implementation of 3D visualization and data output.
- 2008-09: Complete data integration and transition to operations

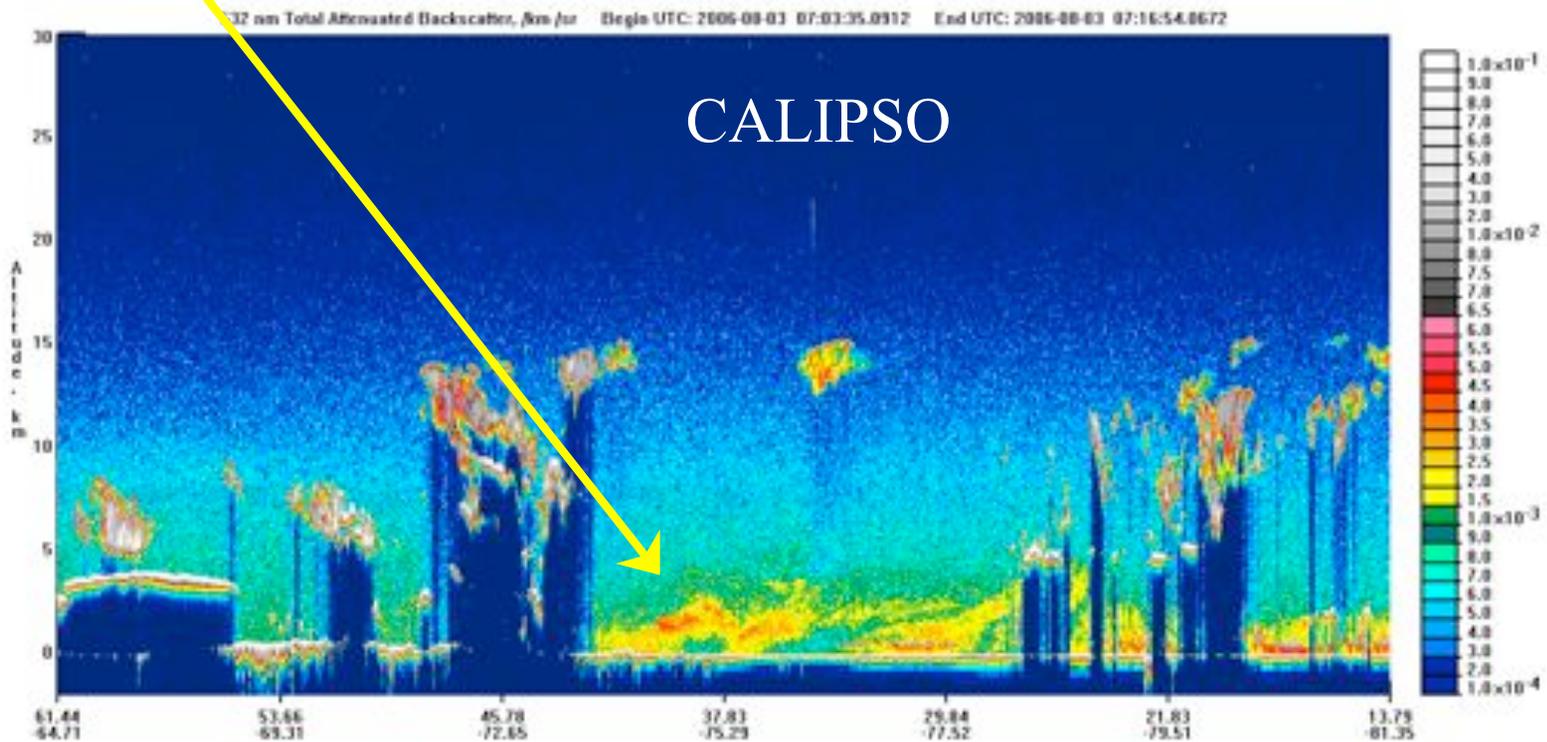
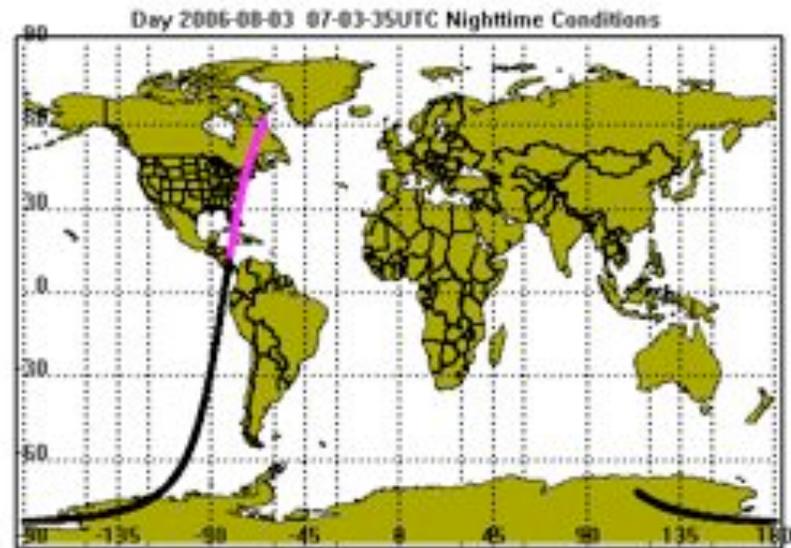
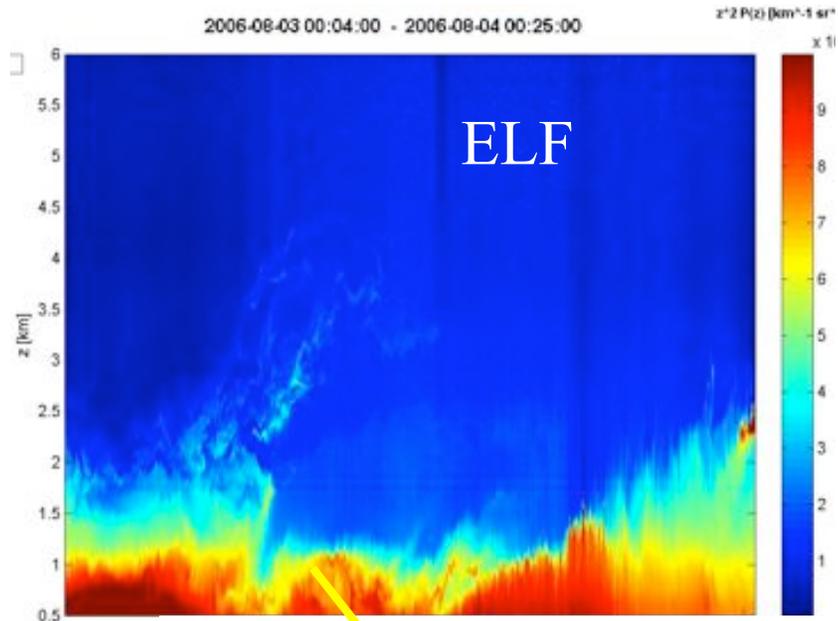
3D-AQS Needs Input

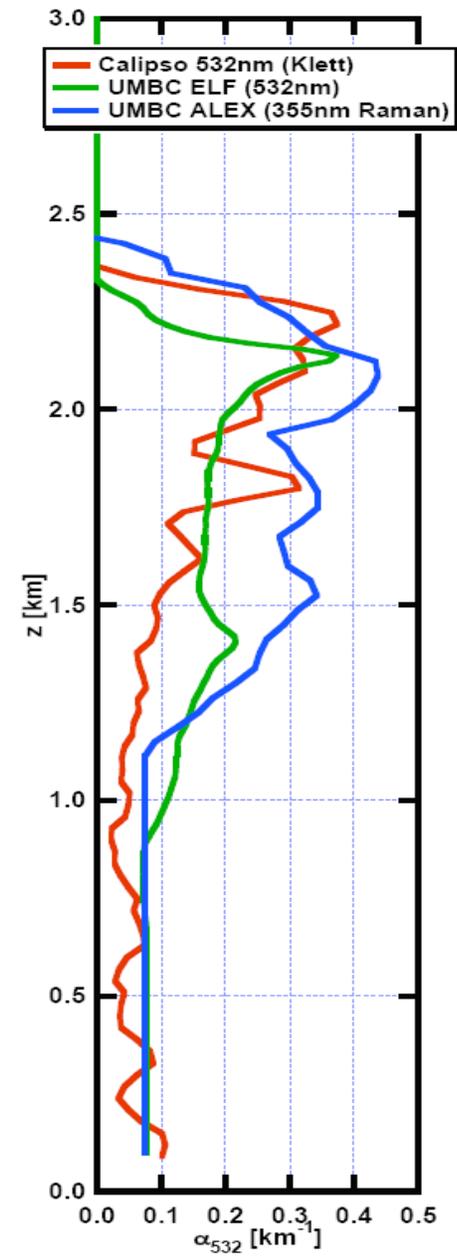
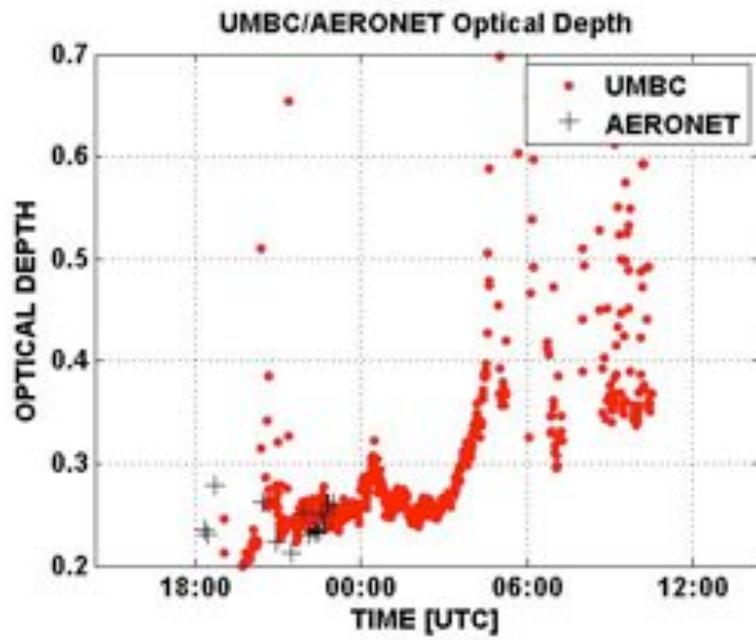
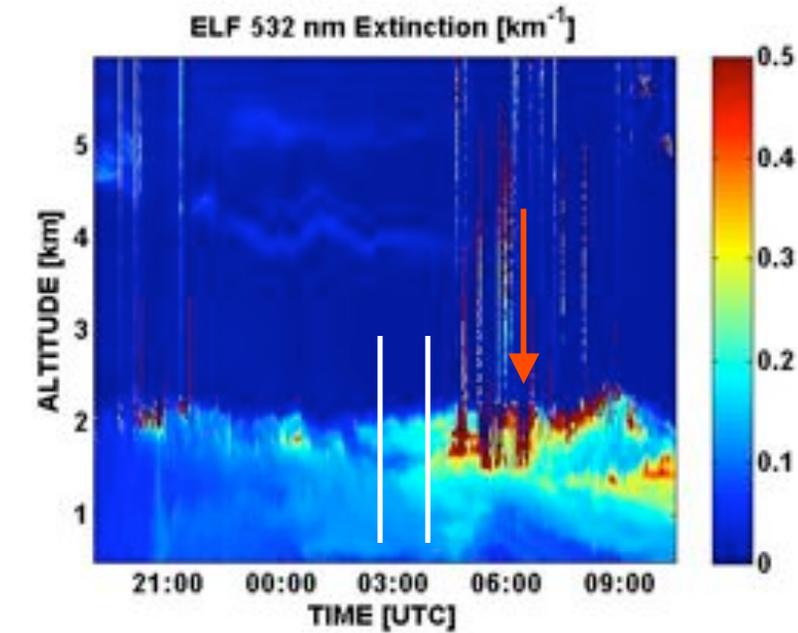
- End user input needed
 - Input sought through end user committee
 - Email always welcome: engelcoxj@battelle.org
- Type of input needed
 - Data types of interest
 - Level of processing and format required
 - Type and style of visualization
 - Temporal and spatial needs
- Better data accessibility = more use and demand for environmental information = greater understanding of our atmosphere

A satellite image of the Gulf of Mexico and Caribbean Sea. The Gulf of Mexico is on the left, and the Caribbean Sea is on the right. The word "Questions?" is overlaid in large, bold, orange letters in the upper left quadrant. The image shows the coastline of North America, Central America, and the Caribbean islands. The ocean is dark blue, and the land is green and brown. There are some white clouds visible in the sky.

Questions?

Backup





August 10, 2006 CALIPSO Validation

